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· THE PUBLISHERS' PAGE ·

On Making and Taking

A LARGE eastern city, which for the purpose of this piece shall be called "Bigtown", has displayed for years on a bridge over its adjoining river an imposing sign to the effect that "Bigtown Makes, the World Takes."

Knowing the significant industries located in that city, no one can doubt the truth of that statement. Neither can one doubt that all over the United States many other "Bigtowns" and even some "Smalltowns" might boast with equal truth of the world-wide or nation-wide markets enjoyed by their products.

What makes this particular sign so interesting, however, is a municipal ordinance by which "Bigtown" provides that in the purchase of all materials for its city departments, prices being equal, preference shall be given to manufacturers located in its state. Moreover, the contracts for such materials provide for factory inspection by a representative of the city; if the materials are manufactured within the state, the city will bear the cost of the inspection, if they are manufactured elsewhere, the contractor must pay for it.

OBVIOUSLY any city has a legal right to establish conditions covering the location of factories from which it would buy, and in its exercise some go even farther than does "Bigtown." But if we assume that every city throughout the nation followed this example, what might be the effect of the world's demand for the products of "Bigtown"? What might happen to the industries of "Bigtown" if all the other communities should erect such barriers against their products?

It is easy to understand how a narrow view of self interest might lead the city fathers of "Bigtown" to believe that they are serving the interests of their people by thus trying to live unto themselves and "keep the business in the family." But, on second thought, it must be obvious that such an advantage can be enjoyed only so long as the "foreigners" continue to purchase the products of "Bigtown." It is nice to eat your cake and have it too, so long as you are able to get away with it.

From time to time this page has reminded its readers that one of the most vital factors in the greatness of this country is its economic unity. Because of it every producer of every commodity and service knows that, subject only to economic conditions, everyone else in the whole United States should be a prospect for his services. It has enabled us to escape the curse of the old world. If we would get some idea why the nations of the old world are so constantly at each others throats, with imminent peril to the whole fabric of civilization, we need but imagine our own land split into forty-eight independent nations, each trying to prosper within its own political and economic walls.

So extreme a condition, of course, does not confront us; yet that is exactly the principle invoked by those cities and states which seek to outlaw purchases from qualified producers located in other states, while at the same time they work to broaden their own markets in those states.

THE first effort to establish an American nation under the Articles of Confederation failed miserably and that failure was due in no small part to the efforts of the states to do just that; so the new Constitution prohibited the restriction of free trade between the states. The wisdom of that provision, based on bitter experience, has been demonstrated by the amazing economic growth of the unified nation.

Whenever "Bigtown" or any other American city restricts in any measure the free purchase of comparable products from qualified producers anywhere in the United States, it violates that principle; it seeks an advantage that it explicitly discredits in its own thoroughly sound and admirable slogan. But if "Bigtown" would make what the world takes, then "Bigtown" should take what the world makes.

Willard Chevalier

· ENGINEERING NEWS-RECORD ·

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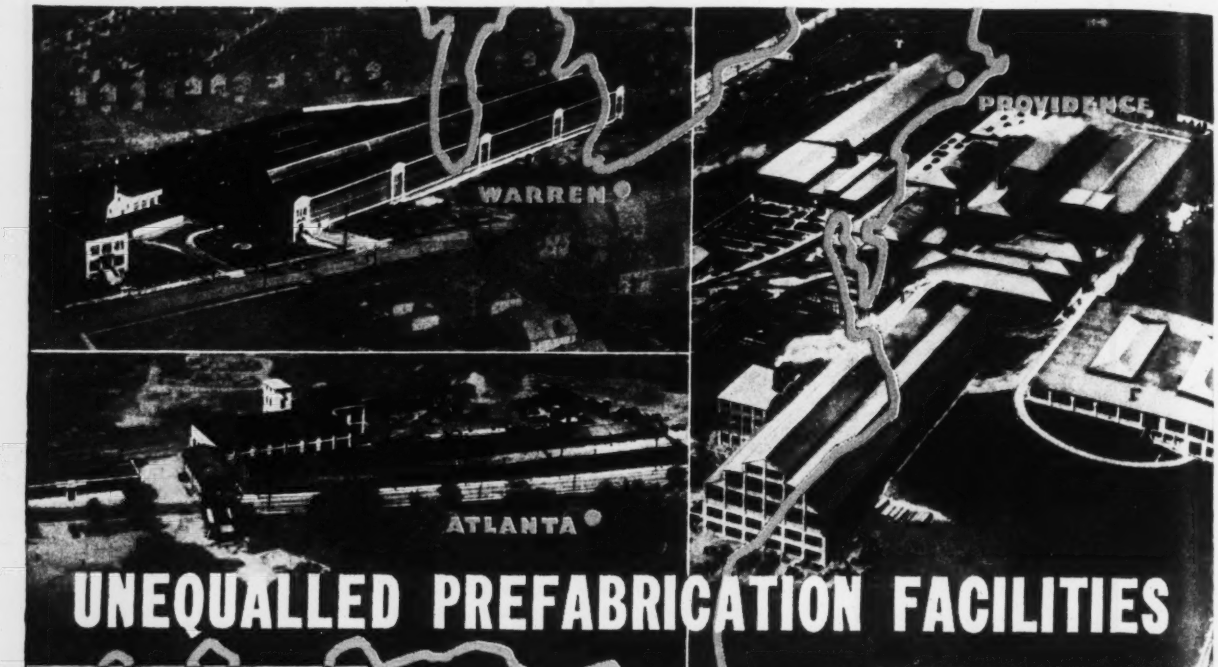

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VOL. 119 *JULY 8, 1937* No. 2

THIS WEEK AND NEXT

NEW ENGLAND lost many bridges in the flood of 1936 and is now engaged in replacing them. Significant lessons growing out of the flood as to channel openings, pier and abutment depth, and satisfactory bridge types are outlined in this issue. Details of the new structures will be given in subsequent issues.

To increase the city's water supply sufficiently to meet the demands of a new large industrial consumer, Charleston, S. C. drove a tunnel 18.6 miles in seven months. The construction program and methods of tunneling through marl as outlined in this issue by J. E. Gibson are of special interest.

Disposal of sewage by distributing it on land used for farming has been practiced in Europe for more than two centuries; its use at Vineland, N. J., a community of 8,000 people, since 1928 is told on p. 63 by George A. Mitchell, manager of the sewage farm.

Several unusual structures have been built for flood channels, or to carry streets over flood channels in the Los Angeles region. Descriptions of them in this issue supplement information on the Los Angeles flood control work published last week.

Experiments with a new type of expansion joint for highway pavement are being conducted in New York State. Results obtained to date are encouraging.

WIDELY used but seldom publicized are municipal hog-farms operated for disposal of garbage. How the method has been made a success at Flint, Mich., both financially and from a sanitary viewpoint, is to be told in next week's issue.

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THE COVER PICTURE is of the new navigation lock at Chickamauga Dam on the Tennessee River. The lock will have a lift of 51 ft. Each leaf of the lower gate weighs 181,000 lb.

"CONCRETE MARKERS WILL SAVE US MONEY-

Installation of precast Atlas White traffic markers in Patterson Boulevard, Dayton, Ohio, was under the direct supervision of Rollin C. Gaylord, Maintenance Engineer of Division of Streets

...In 3 Years' Time the Cost of Painted Lines Will Equal Cost of White Cement Markers"

—H. P. Ullmer, *Superintendent of Streets, City of Dayton, Dayton, Ohio*

Superintendent Ullmer, commenting on the installation of precast Atlas White concrete traffic markers in Dayton, says—

"It is our estimate that in three years' time the cost of painted lines will equal the cost of White Cement markers *and from there on a great saving will be made by the use of concrete markers.*"

This estimate is based on a very careful analysis and comparison of costs made by the City of Dayton.

Atlas White markers save money because they are *permanent.* You install them, and forget them. No maintenance cost. No endless painting of traffic lines. No fading. Atlas White markers *stay* white as long as the pavement lasts—clean-cut, sharply defined, easy to see.

They may be installed in old or new pavements of any type. And even coldest weather doesn't hold up the work. Precast sections, made indoors, are simply moved to the job and set in place. Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), 208 South LaSalle Street, Chicago.

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ATLAS WHITE PORTLAND CEMENT
FOR TRAFFIC MARKERS

· ENGINEERING NEWS-RECORD ·
JULY 8, 1937

THE WEEK'S EVENTS

New England Ratifies Flood Compacts

New Hampshire is last state to approve the Connecticut and Merrimac River interstate compacts

Ratification by the New Hampshire legislature of the Connecticut (*ENR*, Apr. 8, 1937, p. 533) and Merrimac (*ENR*, May 6, 1937, p. 681) interstate flood control compacts leaves only approval by Congress to open the way for a $20,000,000 flood control program in the New England States which would be the first step in a long-range program involving the expenditure of $80,000,000.

The Connecticut River compact, which has already been ratified by Connecticut, Massachusetts and Vermont, provides initially for the construction of eight reservoirs at an estimated cost of about $12,700,000, of which $10,000,000 would be provided by the federal government under the terms of last year's omnibus flood control act, and $2,700,000 would be provided by the states.

Vermont and New Hampshire would each provide only 5 per cent of the states' share of the cost, 50 per cent coming from Massachusetts and 40 per cent from Connecticut.

Of the eight dams, two will be built in Massachusetts, three in Vermont, and three in New Hampshire. The state contributions will provide the necessary land and easements, and the states agree to operate and maintain the dams after their completion.

Construction and operation of the dams will be carried on by a Connecticut River Valley Flood Control Commission composed of three salaried members from each state.

Merrimac compact

The Merrimac River compact, which is subscribed to by New Hampshire and Massachusetts, sets up a Merrimac River Valley Flood Control Commission and provides for the immediate construction of two dams in New Hampshire at a cost to the state of $2,285,000 and to the federal government of about $5,277,000. Ultimately three more dams would be constructed in New Hampshire at a cost of $7,028,000 to the state, and $10,313,000 to the federal government. Federal contributions to this program would also come from the money appropriated under the 1936 omnibus flood control bill.

• • •

River and Harbor Bill Passed by House

The House of Representatives on July 1 passed and sent to the Senate an omnibus bill authorizing the construction of 130 river and harbor projects in all sections of the United States. As passed, the bill includes all projects approved by the committee on rivers and harbors, with the addition of seven projects added on the floor. The total authorized expenditure for the entire list is $33,687,175. No appropriation is made; the bill simply adds the projects to the list of authorizations from which the Chief of Engineers will select those to be carried out with available funds.

Included in the bill is a direction to the Secretary of War to make a pollution study of the Ohio River, with the assistance of the Public Health Service; the official transfer of the Central Valley project in California from the War Department to the Department of the Interior; and provision for compensation to 25 drainage and levee districts along the upper Mississippi River for seepage, backwater and extra pumping costs due to the establishment of the 9-ft. navigation channel.

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A.S.T.M. Meeting Held In New York

Over 1500 attend sessions devoted to materials specifications and testing procedures

Last week, the 40th annual convention of the American Society for Testing Materials, held in New York City for the first time in 25 years, set an all-time record of 1535 registrants; only once before in history—at the 1931 Chicago convention—has the attendance exceeded 1200. A total of 53 new tentative specifications were acted upon, which is another new record. Since the technical sessions were very fully attended and the exhibit of testing apparatus was the largest that the manufacturers have ever arranged, the meeting was an unusually successful one from a variety of viewpoints.

Prof. A. E. White, director, department of engineering research, University of Michigan, was elected president to succeed Arno C. Fieldner, of the U. S. Bureau of Mines. H. H. Morgan, of the Robert W. Hunt Co., was elected vice-president. Added to the board of directors were P. H. Bates, Bureau of Standards; H. F. Clemmer, engineer of materials, District of Columbia; G. E. F. Lundell, Bureau of Standards; H. C. Mougey, General Motors Corp., and R. L. Templin, Aluminum Company of America. The annual meeting next year will be held in Atlantic City, and a regional meeting will be held in the fall at Rochester, N. Y.

Three members of the Society were distinguished by honorary membership, G. H. Clamer, J. A. Capp, and Gustave W. Thompson.

In reporting on the present state of the society, C. L. Warwick, secretary-treasurer, announced a net gain in membership of 251, bringing the total near 4100, against a pre-depression high of about 4400. The growth reflects both business recovery and the effect of new fields into which the society's work has recently been expanded. Among these new fields are soil mechanics, glass and glass products, paper and paper products, soap and detergents and plastics. Mr. Warwick

(*continued on page 45*)

Contract is Awarded For Queens Tunnel

Award to Walsh is based on modification of original bid reducing cost of work

A contract for driving twin tubes for Queens-Midtown vehicle tunnel under the East River at New York was let on June 30 to the Walsh Construction Co. of Davenport, Iowa, for $21,300,000. The contract was let by the New York City Tunnel Authority with the approval of Arthur S. Tuttle, state director of the PWA, which agency is financing the work.

The award is based upon an agreement made with the contractor which provides for a modification of his original proposal whereby a very large saving will result to the tunnel authority. The savings are to be effected in part by a modification in the plan, in part by an allowance for the substitution of securities in place of a performance bond, in part by changing the terms governing payments due the contractor, and in part by a substantial concession by the contractor as to the total cost of the work. These changes together with those resulting from a further study of the volume of work to be done are expected to decrease the cost of the work from about $24,763,000 as set forth in the original bid (*ENR* June 3, p. 840) to about $21,300,000 without prejudicial effect upon the plan as a whole.

The work covered by the contract includes the driving of two cast-iron tubes by shield methods for a distance of about 4,000 ft. through river sand and rock, a construction shaft at the Manhattan end, and the placing of a clay blanket on the river bottom where the cover is shallow. For a map showing the location of the tunnel see *ENR*, Aug. 20, 1936, p. 285.

Construction work for the contractor will be under the direction of J. S. MacDonald, a man of long experience in shield-tunnel work. Ole Singstad is chief engineer of the tunnel commission.

• • •

LIBRARY OVER THE RIVER

RUNDEL Memorial Library at Rochester, N. Y., is built on piers extending out over the Genesee River. Intended as the first unit in a civic center to utilize the space provided by the river flowing through the city, the new library was built by means of a grant of $300,000 from the PWA, and a bequest of $1,000,000 from the late Morton W. Rundel, after whom the building was named. The open space under the building contains the tailrace from a power plant upstream, and the stairway in the foreground leads to a subway.

The Central Library at Rochester was formerly housed in the gabled structure which may be seen on the far side of the river.

Sacramento Flood Control Recommended by Board

Construction by the United States of bank protection works and levee setbacks on the Sacramento River, substantially as included in the five-year program recommended by the California Debris Commission, has been recommended by the War Department Board of Engineers for Rivers and Harbors.

Recommendations of the board also include the maintenance during the construction of these works of the enlarged river channel below Cache Slough, the revetment of banks of the cut in this section, and the maintenance and operation of gaging stations on navigable rivers during this period.

The United States will bear $2,500,000 of the cost, provided that the State of California appropriates funds for the maintenance of the remainder of the project. Before the project goes into effect, it will be necessary for the State of California and political subdivisions to provide without cost to the United States all land, easements and rights-of-way for the proposed work, and to contribute one-third of the cost of bank revetment and levee construction.

• • •

River Diversion Effected At Fort Peck Dam

The Missouri River left its channel on June 24 and flowed for the first time through the four diversion and control tunnels as a small earth dike blocking the tunnels was blasted away and the last gap in the great dam was filled in.

It had been originally intended to effect the diversion of the river on June 26, but a rapid fall in the river June 23, following an equally rapid rise June 13-14, caused a slip in the fill which threatened the railroad bridge at the downstream end of the central gap. It was decided to effect diversion immediately at the downstream end, where the gravel fill would serve the double purpose of closing the gap and protecting the bridge.

At the same time that the diversion tunnels were being opened, bulldozers and derrick boats were dumping heavy boulders into the central channel to serve as sill for the gravel fill. Twenty minutes after blasting of the tunnel barrier, train-loads of gravel began moving onto the bridge across the channel and dumping. Within 134 minutes, 140 carloads of gravel were dumped into the channel, and during the day a total of 298 cars, containing 11,470 cu.yd. of rock and gravel were unloaded, bringing the top of the material well above the surface of the water in the river channel. Flow was definitely stopped and the Missouri was forced to flow through the diversion tunnel.

When closure was completed at the downstream toe, the job still remained of making a second closure at the upstream toe. This work was begun about midnight on June 26, and the material was brought above water surface shortly after noon on the 28th.

As the double closure was effected, three dredges began pumping fill into the four corners of the rectangular channel section of the dam. All dredges, boosters, and other floating plant are now below the dam, busy closing the gap to level off the dam as one continuous structure by the end of the season.

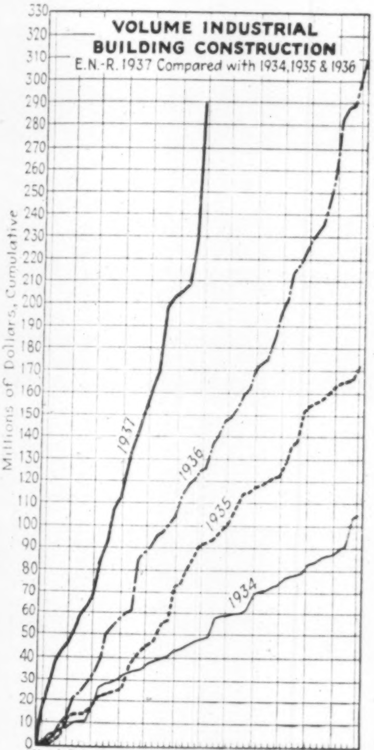
THE CURRENT TREND

This week's news of contract volume and construction cost factors

Plant Building Booms

Contracts for new industrial buildings in first six months of the year approach total for all of 1936

Business prophets of last January were unanimous in singling out industrial buildings as a star performer in 1937. Yet none of these soothsayers had either the nerve or the perception to predict that the volume of factory construction would equal the all-time record of $550 millions set up in 1929. At the halfway mark, however, the total, at $290 millions, is more than half of that remarkable 1929 figure.



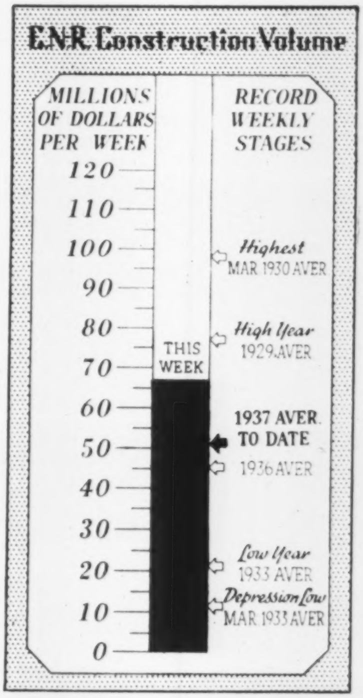
We are in the midst of an industrial building boom that has steadily been gaining force for four years as shown in the accompanying chart. While it may go up and out like a skyrocket, basic conditions, as yet, do not point to such fireworks. In contrast to 1929, when the surge in factory construction followed four years of high volume ($230, $310, $320 and $355 millions) the background of 1937 is much more modest ($150, $100, $170, and $310 millions in the previous four years). Furthermore, prosperity, in 1929 had worn itself out in nearly every industry; in 1937, some industries, that will need new plant facilities have not yet experienced prosperity.

It requires neither nerve nor perception to predict that 1937 will, at the very least, be the second largest year on record since, to accomplish this, it must only exceed the $355 million total of 1928. Such activity in factory construction, reflecting as it does a confidence in the ability of business to return a profit, is probably more significant than present stock market quotations. Construction should derive both monetary and moral support from industry's desire to build.

• • •

INDEX NUMBERS

ENR COST	1913 =100	1936 =100	ENR VOLUME	1913 =100	1926 =100
July, 1937..	241.75	116.21	June, 1937..	245	107
June, 1937..	238.15	114.48	May, 1937..	213	93
July, 1936..	204.40	98.25	June, 1936..	194	85
1936 (Av.)..	206.46	99.24	1936 (Av.)..	185	81
1935 (Av.)..	195.22	93.84	1935 (Av.)..	135	58
1934 (Av.)..	198.10	95.23	1934 (Av.)..	114	50



THIS WEEK'S FIGURES

CONTRACTS

(Thousands of Dollars)

	Week Ending July 9 1936	Week Ending July 1 1937	Week Ending July 8 1937
Federal	$14,267	$9,127	$2,847
State&Municipal	24,281	23,579	43,781
Total public...	$38,548	$32,706	$46,628
Total private	22,299	22,772	20,370
TOTALS .	$60,847	$55,478	$66,998

1937 (27 weeks)..	$1,367,904
1936 (28 weeks).....	$1,219,689

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

	Week July 8	Cumulative
NON-FEDERAL WORK..	$15,358	$640,272
State & mun. bonds..	10,668	285,036
Corporate securities ...	4,690	282,982
PWA loans and grants	......	42,315
RFC loans	......	29,939
FEDERAL WORK	......	......
TOTAL ALL WORK....	$15,358	

1937 (27 weeks)............	$640,272
1936 (28 weeks)............	$479,905

In spite of a short holiday week, engineering construction awards total $66,998,000. And in contrast to recent trends, public works account for more than private awards. The state and municipal total of $43,781,000 is aided by the large award for the Queens-Midtown Tunnel at New York.

New capital is made up of $10,668,000 in state and municipal bonds and $4,690,000 in corporate securities.

THIS WEEK'S LARGE CONTRACTS

Plant—Industrial Rayon Corp., Painesville, O.	$7,500,000
Hospital—Wesley Memorial, Chicago, Ill.	2,000,000
High School—Philadelphia, Pa.	1,850,000
Railway terminal—San Francisco-Oakland Bridge	2,283,000
Sewer—Williams Ave., Brooklyn, N. Y.	1,251,000
Vehicular tunnel—Queens-Midtown river section, New York, N. Y.	21,300,000
Engine terminals—Pennsylvania R.R., Harrisburg, Pa.	1,500,000
Highways—Nebraska .... $1,538,000 Ohio	858,000

Monopoly in Cement Charged by FTC

Federal Trade Commission issues complaint against Cement Institute and 75 manufacturers

A combination to eliminate price competition in cement, involving manufacturers of 95 per cent or more of all the cement made in the United States, is charged by the Federal Trade Commission in a complaint against the Cement Institute, an unincorporated association, and its 75 cement manufacturing member corporations. The complaint alleges violation of the Federal Trade Commission Act and of the Robinson-Patman Act.

The complaint charges that the members of the Cement Institute agreed to quote cement prices at any place equal to the price fixed for certain "basing points" throughout the country plus the freight rate from the nearest basing point to the point of delivery of the cement. This system, the complaint states, makes it impossible for cement users to obtain competitive prices. Thus, it is stated, the state of South Dakota was forced to establish and operate its own cement mill, and the Tennessee Valley Authority was able to obtain a competitive price only by threatening to manufacture its own cement.

In addition to the use of the basing point system, various other improper practices are charged against the manufacturer group. These include penalizing customers who use trucks for delivery and monopolizing for themselves the benefit of cheaper transportation by highways and waterways; the use of misleading propaganda as to the competitive character of their practices; arbitrary division of customers into classes of those who may buy direct and those who may not; arbitrary definition of what middlemen shall be regarded as cement dealers and refusal to permit others to buy; and the use at times of boycotts and espionage of dealers to eliminate competition of foreign cement importers.

In addition to the Cement Institute, the following manufacturing companies are named in the complaint as respondents:

Aetna Portland Cement Co., Detroit; Alpha Portland Cement Co., Easton, Pa.; Arkansas Portland Cement Co., Denver; Ash Grove Lime & Portland Cement Co., Kansas City; Beaver Portland Cement Co., Portland, Ore.; Bessemer Limestone & Cement Co., Youngstown, Ohio; Calaveras Cement Co., San Francisco; California Portland Cement Co., Los Angeles; Castalia Portland Cement Co., Pittsburgh; Colorado Portland Cement Co., Denver; Consolidated Cement Corp., Chicago; Coplay Cement Manufacturing Co., Coplay, Pa.; Cumberland Portland Cement Co., Cowan, Tenn.; Dewey Portland Cement Co., Kansas City; Diamond Portland Cement Co., Middle Branch, Ohio; Edison Cement Corp., New York; Federal Portland Cement Co., Inc., Buffalo; Florida Portland Cement Co., Chicago; Georgia Cement & Products Co., Atlanta; Giant Portland Cement Co., Philadelphia; Glens Falls Portland Cement Co., Glens Falls, N. Y.; Great Lakes Portland Cement Corp., Buffalo; Green Bag Cement Co. of West Virginia, Pittsburgh; Hawkeye Portland Cement Co., Des Moines; Hercules Cement Corp., Philadelphia.

Hermitage Portland Cement Co., Nashville, Tenn.; Huron Portland Cement Co., Detroit; Idaho Portland Cement Co., Inkom; International Cement Corp., New York; Keystone Portland Cement Co., Philadelphia; Kosmos Portland Cement Co., Louisville; Lawrence Portland Cement Co., Siegfried, Pa.; Lehigh Portland Cement Co., Allentown, Pa.; Marquette Cement Manufacturing Co., Chicago; Medusa Portland Cement Co., Cleveland; Missouri Portland Cement Co., St. Louis; Monarch Cement Co., Humboldt, Kansas; Monolith Portland Cement Co., Los Angeles; Monolith Portland Midwest Co., Los Angeles; National Cement Co., Birmingham; Nazareth Cement Co., Nazareth, Pa.; Nebraska Cement Co., Denver; North American Cement Corp., Albany; Northwestern Portland Cement Co., Seattle; Northwestern States Portland Cement Co., Mason City, Iowa; Oklahoma Portland Cement Co., Denver; Oregon Portland Cement Co., Portland; Pacific Portland Cement Co., San Francisco; Peerless Cement Corp., Detroit; Pennsylvania-Dixie Cement Corp., New York; Petoskey Portland Cement Co., Petoskey, Mich.; Pittsburgh Plate Glass Co., Pittsburgh; Portland Cement Co. of Utah, Salt Lake City; Riverside Cement Co., Los Angeles.

Santa Cruz Portland Cement Co., San Francisco; Signal Mountain Portland Cement Co., Chicago; Southern States Portland Cement Co., Rockmart, Ga.; Southwestern Portland Cement Co., El Paso, Texas; Spokane Portland Cement Co., Spokane, Wash.; Standard Portland Cement Co., Cleveland; Superior Cement Corp., Portsmouth, Ohio; Superior Portland Cement, Inc., Seattle; Three Forks Portland Cement Co., Denver; Trinity Portland Cement Co., Chicago; Union Portland Cement Co., Denver; Universal Atlas Cement Co., Chicago; Valley Forge Cement Co., Catasauqua, Pa.; Volunteer Portland Cement Co., Knoxville, Tenn.; Vulcanite Portland Cement Co., Philadelphia; Wabash Portland Cement Co., Detroit; West Penn Cement Co., Butler, Pa.; Whitehall Cement Manufacturing Co., Philadelphia; Wolverine Portland Cement Co., Coldwater, Mich.; and Yosemite Portland Cement Corp., Merced, Calif.

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PWA Will Not Accept Further Requests

Non-Federal applications for PWA allotments will no longer be accepted, in accordance with the provisions of the Public Works Administration extension act of 1937, which has been enacted by the signature of the President after passing House and Senate.

Applications have been accepted for more than four years since the Public Works Administration was first established June 16, 1933. During that time, non-federal applications have been filed for 25.323 projects seeking allotments totaling $7.365.000.000 as loans and grants for permanent useful public works having a total construction cost of $10.146.046.000. There remain pending sufficient filed projects in advanced stage of preparation to be dealt with under the funds available through the Public Works Administration Extension Act of 1937.

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Foundation Expert Dies

Daniel E. Moran, leading authority on foundations and deep caisson work, senior member of the consulting engineering firm of Moran, Proctor & Freeman, died at his home in Mendham, N. J., on July 3, followed a short illness. Mr. Moran had been in poor health for some time past. He was 73 years old.

A full account of Mr. Moran's notable career will be given in a subsequent issue.

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Rhodesia Suspension Span Contract Let

Dorman, Long & Co., Middlesbrough, England, have contracted for the erection of a 1500-ft. steel suspension bridge over the Churunda Gorge on the Zambesi River. The new bridge will form another link between North and South Rhodesia.

In addition to the central span, there will be four short approach spans each 40 ft. in length. The main span of the bridge will be supported by two 8-in. steel cables anchored in the rock on each side of the river and passing over steel towers on the river banks.

A.S.T.M. Meeting

(continued from page 41)

surpassed any previous one in the volume of publications issued, the total number of pages being 6750 as against 4600 last year and 5900 in 1933 when the book of standards was issued, as it was also in 1936. About one-third of the society's present income results from sales of publications, a total of $45,290 being realized last year.

The society awarded its Charles B. Dudley medal to W. H. Swanger and G. F. Wohlgemuth of the Bureau of Standards for their paper on "Failure of Heat-Treated Steel Wire in the Cables of the Mt. Hope Suspension Bridge." The Edgar Marburg lecture, a convention feature, was delivered by Dr. T. Smith Taylor, manager of the engineering laboratory of Diehl Mfg. Co., on the subject "Plastics: Some Applications of the Different Classes, and Methods of Testing."

The reports of the society's committee's on standards and on research reflect unusual activity. According to Cloyd M. Chapman, chairman of the committee on standards, the year has witnessed the organization of five new technical committees, a new record. Publication of the triennial book of standards brought the society's standardization activities to a peak during the past year. Representative and comparative figures are as follows: new tentative standards, 52 last year as compared with 48 the previous year; revisions of existing tentative standards, 48 as against 38; tentative revisions of existing standards, 28 as against 7. On the other hand, the advancement of tentative standards to standard and the revisions of existing standards recommended for adoption as standards was only about one-third as great. There are at present about 513 standards and 285 tentative standards of the society, making a total of 798 previous to last week's meeting, and if all recommendations made there are approved, the total will become 822.

P. H. Bates, chairman of the committee on research, reported that the total of the research fund is slightly over $19,500, and that from now on the society will devote half of the receipts from dues to the research fund. This latter practice was discontinued during the depression. Grants were approved during the year for a continuation of the study at the University of Illinois on the effect of speed of testing on the properties of concrete; for an investigation at Rensselaer Polytechnic Institute of the methods of capping structural clay tile; and for fatigue tests of cast iron at the University of Wisconsin.

The important research committee on yield point of structural steel, which has been functioning since 1926, presented a final report and was discharged.

Technical activities entered five new fields during the past year. At the beginning of the year soil testing and the subject of soaps and detergents were taken up for committee study, and at last week's meeting three subjects were added: glass and products, paper and products, and plastics. In each case the need for work by the society arose chiefly in connection with test methods. Requests have also been made for work on thermal insulating materials, and a committee on this subject may be set up later.

Coordination of the society's diversified lines of work has been found necessary in some instances. The work on brick and that on hollow building units has been combined under a single committee.

The technical report of the meeting will be published next week. Among the subjects to be covered will be developments in steel, wrought iron, impact testing, corrosion resistance, cast iron, bituminous materials, paint, cement and concrete, masonry materials, consistency measurements, timber and methods of testing.

Marine Parkway Bridge Opened July 3

The $6,000,000 Marine Parkway bridge over Rockaway Inlet, built in less than a year, was opened July 3. The bridge joins Marine Park in Brooklyn with Jacob Riis Park and is expected to pay for itself in 25 years.

The bridge is about 3,800 feet long, contains three 540-ft. through-truss spans at the center and continuous deck-truss span approaches. The center span is the second longest lift span in the world.

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Unusually Low Bids On Texas Job

Unusually low bids were recorded at the third letting of contracts for construction work in connection with the completion of the $4,853,000 Public Works Administration irrigation project of Willacy County Water Control and Irrigation District No. 1 of Raymondville, Texas.

The total amount of the tentative awards was $339,000, about 22 per cent below control estimates. The canal work was divided into eight separate schedules and low bids on each of these were accepted pending approval by PWA.

Public Service Urged At Teachers Meeting

Engineering educators emphasize need for social training of engineers

The broader aspects of engineering education, particularly the responsibility of teachers to train their students in more effective social service as practicing engineers, featured the 45th annual convention of the Society for the Promotion of Engineering Education, held last week at Cambridge, Mass. Nearly 60 per cent of the entire membership was represented in the registration of 1,571 at the meeting.

Although engineering pedagogy formed the backbone of the program, the great need for engineers to recognize the special call on them for greater public service regarding present day problems was the underlying theme of the meeting. Harry P. Hammond, in his presidential address, voiced this need, and outlined the intangible qualities that differentiate the great teacher from the mere instructor. President K. T. Compton of the Massachusetts Institute of Technology discussed in an illuminating manner the relation between educational institutions and industry, and President Henry W. Wriston of Brown University challenged the current belief that a dead center has been reached in economic productiveness. The speaker looked to the engineering profession to provide more of the imagination and human understanding required in the future development of society along technical lines.

Dean F. E. Turneaure of the University of Wisconsin received the Lamme medal of the society at the annual dinner Thursday evening. The Massachusetts Institute of Technology and Harvard University acted jointly as hosts during the week.

New officers elected are: President, Dean S. B. Earle, Clemson College, S. C.; first vice-president, President Karl T. Compton of the Massachusetts Institute of Technology; second vice-president, Dean F. C. Bolton, Texas A. & M. College; treasurer for the 31st year, W. O. Wiley, New York; and secretary for the 24th year, F. L. Bishop, University of Pittsburg. Council members elected were Dean G. F. Eckhardt, University of Vermont; Dean S. C. Hollister, Cornell; Prof. D. S. Elliott, Tulane; F. M. Feiker, executive secretary American Engineering Council; R. W. Sorenson, California Institute of Technology; Prof. A. H. White, University of Michigan, and F. B. Seeley, University of Illinois.

Beautiful Bridges Get Awards

A.I.S.C. names Triborough span most beautiful in monumental class

The East River crossing of the Triborough Bridge at New York City has received the award of the American Institute of Steel Construction as the most beautiful bridge of monumental size completed and opened to traffic during 1936. The hurricane deck bridge at Lake of the Ozarks, Missouri, received the award in the medium size class, and the Astoria Boulevard bridge over Grand Central Parkway extension at New York City was judged to be most beautiful in the small span class.

An unusual number of excellent bridges of monumental size entered in the contest led the jury to select three bridges in this class for special mention. They are the Henry Hudson bridge over the Harlem River in New York City, an 800-ft. hingeless steel arch, the West Bay crossing of the San Francisco-Oakland Bay bridge, and the Fore River bridge in Massachusetts, which is a 219-ft. double bascule.

The jury of awards in the contest consisted of Harvey W. Corbett of the New York City architectural firm of Corbett & MacMurray; Leonard Schultze of the New York architectural firm of Schultze & Weaver; Clarence W. Hudson, New York consulting engineer, retired; Robert Ridgway, New York consulting engineer; and A. Lawrence Kocher, editor of the Architectural Record.

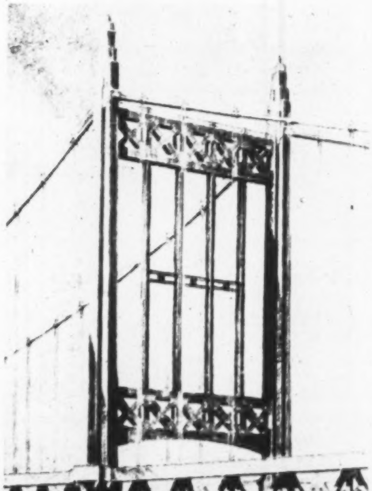
The East River crossing of the Triborough bridge was completed by the Triborough Bridge Authority July 11, 1936, at a total cost of $8,500,000. It has a span length of 1,380 ft. and a width of 113 ft. The chief engineer on the project was O. H. Ammann. Allston Dana was engineer of design, and Leon S. Moisseiff was consulting engineer Aymar Embury II was the architect, and the fabricators were the American Bridge Co. and the American Locomotive Co.

The hurricane deck bridge across Sage Arm of the Lake of the Ozarks on Missouri Route No. 5, Camden County, Mo., was opened Dec. 28, 1936 and cost $656,000. Engineers on the bridge, which is owned by Camden County, were Sverdrup & Parcel. Stupp Bros. Bridge & Iron Co. fabricated the structural steel and sublet the erection to the Wisconsin Bridge & Iron Co. The bridge consists of three central spans, each 464 ft. long, and two side spans of 377 ft.

The $114,000 bridge built by department of parks, New York City, to carry Astoria Boulevard over Grand Central Parkway extension, was designed by the Long Island State Park Commission and the Triborough Bridge Authority and fabricated by the American Bridge Co. Opened to traffic July 11, 1936, the bridge has a span length on skew of 92 ft. and square of 74 ft. 8 in.

HURRICANE DECK BRIDGE, built over Sage Arm of the Lake of the Ozarks in Camden County, Mo., by the county.

ASTORIA BOULEVARD bridge over Grand Central Parkway extension in the borough of Queens, New York City.



EAST RIVER CROSSING of the Triborough bridge at New York City.

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Boston Subway Extension Will Soon Begin

Construction of a 1,165-ft. twin-tube branch extension of the Boylston Street subway from Copley Square under Huntington Avenue, Boston, to the Mechanics Building, is to begin at once under direction of Col. T. F. Sullivan, chairman of the Boston Transit Department. This will be a WPA project, and the estimated cost is $2,044,800, of which the federal government is to contribute $1,272,000.

About 75,000 cu.yd. of open cut excavation will be required, with 3,000 cu.yd. under the Boston & Albany railroad. The tube will be designed with future extension to or beyond Massachusetts Avenue in mind, and the work is expected to require one year, with 1,000 men employed at the peak of construction. Surface car transit will be eliminated from the Copley Square area and lower Boylston Street as a result of this project.

Seattle Contractors Draw Up Code

Voluntary code provides for joint wage agreements and uniform bidding practice

Members of the Seattle Construction Council have adopted a voluntary code of fair competition, and the Council is now seeking cooperation of local architects in enforcement of the code regulations. The council, which has more than 200 members, proposes to enforce the code by confining business to members although "being careful to avoid unduly restricted limitations on entrance for those who wish to join and comply with the code."

The Council is divided into thirteen divisions, each with its own organization and administrative set-up, representing various divisions of the building industry, including general contractors, residential contractors, various types of specialty contractors, building materials dealers, manufacturers and jobbers.

Code Provisions

The fair practice code includes the following provisions:

The council's board of control shall periodically confer with labor representatives on wages, hours and working conditions.

General contractors shall submit competitive bids only on Tuesdays, Wednesdays, Thursdays and Fridays, at a definite hour and place.

Contract awards shall be made on the basis of bids as submitted. This provision is enforced by a requirement that if all bids on any project are rejected for any reason other than irregularity on the part of the bidders, no member of the council shall submit a new bid for ninety days, unless substantial changes are made in plans and specifications.

The council invites filing of duplicate competitive bids in a central depository, to be made public to the bidders after the opening of the original bids.

Employers within the council shall enter into no "labor only" contracts.

Except on public work other than buildings, general contractors shall not submit unit prices on an unwarranted number of alternates in the original bid, unless they are required after the general bid has been accepted.

General contractors shall submit no bids on changes in plans and specifications for any project on which bids are then under consideration unless the contractor is one of the original bidders and has assurance of receiving a contract in case the project is carried through.

No member of the council shall receive any discount from materials dealers greater than that available to any other member.

In case sub-bids are invited by a general contractor in connection with a job on which bids have been advertised, such bids shall be submitted only to the contractors and not to the architects or owners.

A general contractor shall not give information to any sub-contractor relating to the bid of any other subcontractor.

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Pennsylvania Road Dept. Makes More Changes

W. T. Coverdale, superintendent of highways in Erie County, was discharged July 2 in a brief telegram from State Highway Secretary Van Dyke. Thomas W. McGregor was immediately appointed as his successor; Mr. McGregor was formerly principal assistant to the superintendent of Berks County.

It is stated that Mr. Coverdale's discharge was not connected with the recent gravel scandal (*ENR* June 10, 1937, p. 854); his dismissal had been rumored before the scandal broke. It was Mr. Coverdale who precipitated the scandal by refusing, as superintendent in District 1, Erie County, to accept the inferior gravel which the Pioneer Materials Company is said to have supplied.

To date the state has taken no action toward prosecuting those involved in the scandal.

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Bay Bridge Trolley Work Progresses

Construction for the San Francisco-Oakland Bay Bridge electric railway facilities is progressing at both ends of the bridge.

At the Oakland end, 50 per cent of the 250,000 tons of fill material has been placed at the Key Route Mole for storage yards and bridge trains. Concrete for the foundations of 20 piers of the Port of Oakland Overhead has been poured and piling for 20 catenary bridges has been driven to a depth of 126 ft. The Santa Fe Railroad Co. and the Southern Pacific Co. are moving their interchange yard to clear the site for the construction of the overhead Y structure at 26th St.

In San Francisco the terminal area west of First St., and the area between Fremont and First Sts. are being cleared and are expected to be ready for the superstructure contractor by the end of July.

Pollution Control In Pennsylvania

New law empowers board to forbid pollution of waters and provides heavy fines for violation

Declaring that the discharge of sewage and industrial wastes into the waters of the State is not a natural use of those waters, the LaRue bill signed recently by Governor Earle forbids the pollution with sewage or industrial wastes of any waters of the commonwealth, except as permitted by the Sanitary Water Board of the Department of Health. Pollution is defined in the act to include introduction of any substances which will render water unclean to the extent of being harmful to the public health or to animal or aquatic life, or will be detrimental to the use of the water for domestic water supply, for industrial use, or for recreation.

Any person or municipality now discharging sewage may be ordered to stop doing so at any time by the board, without regard to any previous permit under which it may have been discharging sewage. It is provided that any person refusing to comply with such an order of the board may be fined up to $100 for each offense and $10 a day for such time as the offense continues.

A municipality directed by the board to cease pollution of waters must construct treatment plants of a design satisfactory to the board. If there is no money available for such construction, and if bonds could not be sold without exceeding the municipality's debt limit, or if the voters refuse to approve a bond issue, the municipality must issue non-debt revenue bonds secured by sewer rentals.

Sewage permits

In any case in which the board finds that discharge of sewage or industrial wastes is necessary and is not in fact detrimental to the use of the waters involved, it may issue a permit for such discharge. Such permits may be revoked at any time by the board, and the board may never issue a permit to discharge sewage into any waters which are not now receiving any sewage or industrial wastes.

Industrial wastes

The act forbids the discharge of industrial wastes into waters of the state, except as permitted by the board, and requires that all persons who are now discharging such wastes must file notice of the fact with the board within 90 days after passage of the act.

(Continued on page 76)

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Construction on Relief

Sir: About four years ago you kindly published a letter of mine in which I suggested the formation of a strong board composed of leaders in the engineering, contracting and allied construction fields with the purpose of promoting the general building welfare in the course of the then approaching government financing. Unfortunately, such an economically and politically informed board did not arise from the chaotic conditions prevailing at that time, and of course I did not expect my own feeble suggestion to have any particular weight.

What has been the result of the lack of such an economically informed and politically advised body devoted solely to the fundamental welfare and restoration of the construction field? This question is best answered by considering the groups which have enjoyed a high degree of recovery from government financing, and seeing how they took care of their interests. Once the farmer got his crop loan, he was the man that ran his farm. Once the banker got his aid, he was the man that ran the bank. Once the railroad got its loan, its own staff operated the trains. But the wonderful construction system which built this nation was considered incompetent to handle building contracts on the oldtime basis, so a marvelously entangling scheme of redtape strapped the hands of the builder to his side at every turn as though he could not contract to give a certain type of job under proper specification and inspection. He could not select his labor to fit the task, but must have it sent to him upon the judgment of an ex-salesman, ex-clerk, or ex-what-have-you who happened to be in that particular governmental labor management job. And this is the bright spot in the picture, the part occupied by the builder still able to finance a contract under very difficult requirements.

The major portion of construction has been, and still is on relief. CWA was unavoidable, just a panic after the wreck. But the leading construction brains had ample time to analyse FERA and WPA. An informed board should have been appalled at the tendered working conditions offered the engineer and practical job superintendent under these plans.

Can the construction industry plan for itself and use its own strength to realize its plans, or is it forever doomed to only accept and execute the plans of others? If so weak, it will be a long time getting off "relief."

May 31, 1937.
Columbia, S. C.

E. L. Roberts

Cloudburst Flood Formulas

Sir: With reference to Mr. Gutmann's "New Cloudburst Flood Formula" in Engineering News-Record Oct. 1, 1936, p. 474, and subsequent letters to the editor from Messrs. John W. Pritchett and George C. Commons, there may be some advantage in recording the writer's observations.

I was in charge of river gaging in the Bombay Presidency (India) for several years and in 1930, in collaboration with A. J. DeSouza, wrote Technical Paper No. 30 of the Government of Bombay, Public Works Department entitled "A Critical Study of Runoff and Floods of Catchments of the Bombay Presidency."

River gaging was carried out on rivers with catchments varying from 50 to 24,000 sq. mi. Although it was not uncommon for extraordinary floods to be reported, they were usually found to be grossly exaggerated. Discharges frequently had to be calculated by measuring the slope from flood marks, assuming a rugosity value, ignoring effect of a supercharge of bed silt, and assuming the same section as before or after the flood had passed. It was found that:

(a) Observers had a strong tendency to over-estimate phenomenal floods.

(b) Slope measurements were liable to considerable error,

(3) Surface slope often exceeded bed slope and so was not a true measure of energy gradient, on which discharge depends,

(4) Changes in river section occurred during flood,

(5) Loss of energy resulted from standing waves—especially in hill torrents.

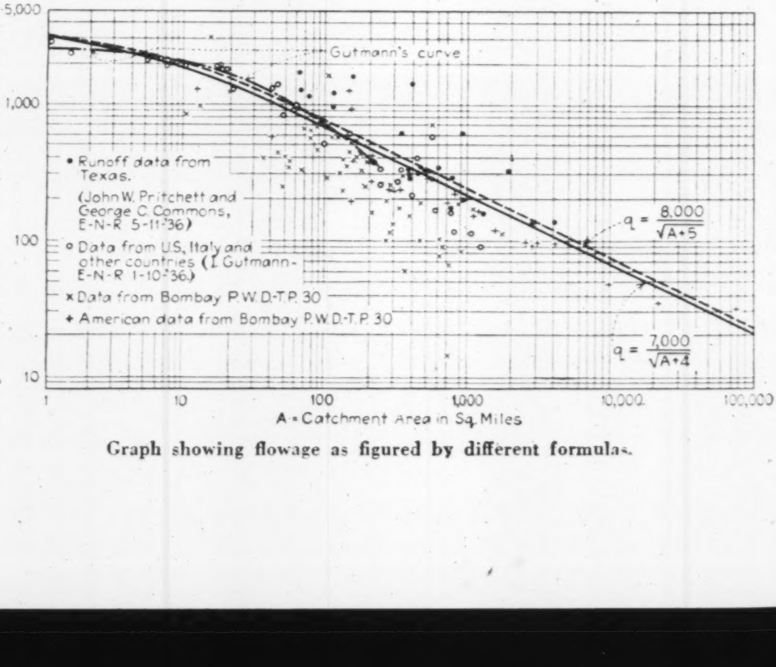
In their Hydroelectric Handbook, Creager and Justin evolve the following formula for a maximum flood:

$$Q = 6{,}000\sqrt{A}$$

Where Q = discharge in sec.-ft. and A = area of catchment in square miles.

From the Indian data the writer independently worked out the formula $Q = 7{,}000\sqrt{A}$. This formula, when written as run-off per square mile of catchment, becomes $q = 7{,}000/\sqrt{A}$.

Although suitable down to catch-



Graph showing flowage as figured by different formulas.

ments of about 10 square miles, this formula is unsuitable for smaller catchments; but by modifying it to $q = 7{,}000/\sqrt{A + 4}$ (which is shown as a full line on the accompanying graph) it is applicable to all sizes of catchment. This gives a discharge of 3,500 sec.-ft. for an infinitely small catchment, equivalent to a run-off of 5½ in. per hour, which is approximately correct.

This formula fulfills Messrs. Pritchett and Commons' dictum that "a formula if applicable at all should apply equally as well to areas up to several thousand square miles."

A formula $q = 8{,}000/\sqrt{A + 5}$ which is shown by a dotted line on the graph, may at first sight appear to be better than the writer's formula; but the 10 per cent excess over the writer's formula is much more likely to be an excess error in observation of discharges than an indication that the formula is too low.

Only very few discharges lie appreciably above this curve, namely: ten points in the Texas data and one on Texas from the Creager and Justin compilation: one from Iowa; one from Gutmann's data for San Catarina, Monterey, Mexico, and finally three from the Indian data (Tech. paper No. 30) of the three last named two are definitely valueless and the third is untrustworthy.

My only objection to Mr. Gutmann's formula, which agrees fairly well with the writer's formula for small catchments (see dotted line on the graph) is that a single formula is simpler and is not liable to be misapplied, as occurred in the case of Mr. Gutmann's formula in this correspondence.

May 21, 1937 C. C. INGLIS,
Poona, India Director, Central Irrigation and Hydrodynamic Research Station, Poona

Engineers and Unions

Sir: I was very interested in a letter on engineers and unions by Louis Roberti (*ENR* June 17, p. 896) and as a result of my own experience can hardly agree that in the matter of finding a solution to the perplexing problem of unemployment and starvation wages for employee-engineers we may with safety leave such solution to the professional societies.

As a registered professional engineer in both Connecticut and Wisconsin and a registered land surveyor in Florida I know something of the operation of emasculated registration laws. To give a specific instance, in Wisconsin a man of little or no training may be sent out in "responsible charge" of construction while it is contended that it is his firm which is in charge. When the committee on registration met to frame a registration law for Illinois, the writer both by telegram and letter brought out this shortcoming and fought against the bill on account of its exemption features.

Why did a registered professional Engineer fight against the passage of a registration law for engineers in his own state? Simply because the old avenues of exploitation would not be closed; because we older engineers are not even given an opportunity for employment because cheaper and less experienced men could be had for a song.

It has come to the point where a good strong union is necessary. No longer can we depend upon ethical concepts. The law of the jungle still holds. We must not be kidded by ideals of "professionalism" so often enunciated by professors who do not realize conditions in the field or by arm-chair consultants high in the councils of the larger societies. Engineers must wake up and take note that only by concerted action can they ever hope to secure that measure of compensation which is rightfully theirs.

June 27, 1937. WILLIAM STACK
Park Ridge, Ill. Registered Professional Engineer

Unionization of Engineers

Sir: Your editorial in the May 27 issue indicated that the decision of the engineer to join an engineers' association or union was to forget principle and be unprofessional. An engineer cannot feel that he is a professional when he is paid a salary less than a union laborer or mechanic, and must bear the offense of their unspoken mockery during the daily execution of his duties on the job; or take home his salary to find it much too small to supply the unextravagant necessities that a professional man instinctively wishes and hopes to give his family.

The writer recently made a salary survey of 25 engineering offices, in order to determine whether or not the demands of 250 fellow engineers were fair. They requested him to be one of an employee committee of three to negotiate for salary increases. The results of this survey were mortifying in the clearness of its evidence that the salary level is a present blight upon the profession.

My survey brought out further that the average or better than average engineer works more hours for considerable less pay than the organized construction mechanic. Such a situation as this is untenable. Heretofore, many of us have refused to act as an organized body, to remedy this situation, on the grounds that to do this would be unprofessional. We now see the laxity of ours is the very height of unprofessionalism, for while we stalled the profession has made a fair start at sliding out of the professional brackets altogether. The engineer has played the part of hopeful waiting long enough. Let him now take part in an organization which works for his economic, as well as his scientific advancement.

June 26, 1937 M. A. HANSEN
Jersey City, N. J.

[The last paragraph of our editorial of May 27 has been so widely misunderstood that some clarification appears desirable. The statement "There is no present need for engineers to join labor unions, either voluntarily or unwillingly under the false impression that they have no alternative" was not directed to the general question of whether an engineer must join a union to improve his economic status, but was an answer to the present very specific challenge put up to many engineers in industries where unionization drives are on, as outlined in the opening paragraph. These men are being told that they must join the vertical union in their industry, whereas, the fact is that no one can compel them to join.

If the professional societies cannot correct the pay situation, the junior grades of engineers may find it necessary to join a union, but they need to recognize that such action will automatically take them out of a professional classification. Thus unionization cannot but widen the gap between the engineer employer and engineer employee, which is highly undesirable.—EDITOR]

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JULY 8, 1937

DIVERSION OF THE MISSOURI brings construction of the Ft. Peck dam to its final problem. Due to the careful preparatory work the diversion took place without incident, and the volume of closure embankment remaining offers no serious task with the equipment and operators that have established the records of the last two years. The closure fill, however, presents the delicate problem of bonding the final section of embankment with the older parts that flank it on each end. To build the flanking sections by hydraulic fill, the ends at the gap left to carry the river had to be constructed of dry fill. These two fills form zones through the dam that sever the hydraulic fill with its middle core of water-deposited material into three parts. Unless the bond between these parts is sound and tight a definite hazard to the dam will develop as hydrostatic head piles up with the filling of the reservoir. It is in this respect that the closure fill interests every engineer who has watched the progress of the great earth structure at Ft. Peck.

Beneficial Floods

INVARIABLY and quite naturally, floods are evaluated in terms of millions of dollars of losses; never are they looked upon as beneficial acts of Nature. Yet in many instances they bring compensating gains. The deposition of rich soil on worn-out acres is most often cited. But another gain is the destruction of obsolete or unsafe structures that survived because of procrastination and false economy. The record-breaking New England floods of 1936 furnished a striking example of this kind of benefit when they destroyed nearly 700 bridges, which are now being rebuilt to modern and safe standards. No more than a dozen of the number were modern bridges, and only one of these was a large structure. The $13,000,000 replacement cost is by no stretch of the imagination a fair measure of loss, for construction of the new bridges with federal funds represents an improvement that without the flood would have required at least 25 years to accomplish. Actually, the floods were a blessing in disguise, and if it were not for the human suffering and private property damage that such floods cause one might wish them on a number of other sections of the country where new bridges are sorely needed.

Appreciation of Form

FOR NEARLY TEN YEARS the American Institute of Steel Construction has annually awarded a prize to the bridge of best appearance. In doing so it has undoubtedly given a strong impetus to bridge esthetics. Praise is due an industry when its official association takes so advanced a view of its business responsibilities as to consider the social influences that lie in esthetically satisfying appearance of its product. Time was when every steel bridge was denounced as awkward and ugly; for years leading bridge engineers have worked to wipe out this reproach. Progress has been made since the days when cast iron rosettes on plate grider rivets were considered beautiful, through the period of dispute over the beauty of curved truss members as against straight members, to the present-day admiration of boldly conceived and well-proportioned outlines. The A.I.S.C. awards will help to continue this program, doubtless with as much gain in efficiency as in beauty.

Through Better Testing

KNOWN BEST for its many specification activities, the American Society for Testing Materials does its most interesting and perhaps also most valuable work in connection with improvement of methods of testing. Many questions as to the usability of materials have resisted all attempts to explore them until a new or more precise test was applied. Of the problems that remain refractory, many await the discovery of some searching test. An example is the workability of mortar and concrete, mentioned in this column last week. Others are corrosion resistance and impact strength of metals; since sensitive testing means better knowledge of materials, it is gratifying to find that the society's research committee on Yield Point was able to sum up its ten years of investigation in the recommendation that the commercial methods of determining yield point should be improved. Beyond question, the strength of structures should be established by dependable data. More precise testing, by giving us better knowledge of strength and reducing the need for large margins of safety, should prove profitable to producer and user alike.

Making Progress

FOR NEARLY A DECADE no meeting of concrete technicians has been complete without a paper on volume-change research. In corridor and luncheon table conversation also the subject has held first rank. But the ordinary concrete user remained indifferent to the scientific talk of the researchers.

And properly so, because knowledge of shrinkage and plastic flow, the two principal manifestations of volume change, was too fragmentary and uncertain to apply to actual design. A change in this situation was reflected in a paper presented at the A.S.T.M. convention last week based on University of California researches. This laboratory, a leader in volume-change study, has produced many pages of data in the past, but none of its reports comes as near to the concrete designer's level as the latest one, to be abstracted in a later issue. Although the investigators still are unable to state the precise effect of plastic flow on stress distribution, they report actual figures for flow deformations, load redistribution between steel and concrete, stress changes due to temperature variation, and the effect on plastic flow of cement fineness, water-cement ratio and aggregate-cement ratio. These are practical design factors, not mere research results. Their presentation marks a definite step forward.

Down on the PWA?

CORRESPONDENTS HAVE ASKED on several occasions recently why we are "down on the PWA". Behind the question is the implication that this journal's endorsement of proposals to liquidate the PWA is a reflection on the engineers who are carrying on the PWA operations. No such reflection is intended, nor would it be justified.

This journal was among the first to advocate setting up the PWA because it believed that there was great need for such an agency as a *temporary emergency measure*; now that the emergency is past it should be among the first to advocate dissolution just as quickly as can be done without injury to PWA commitments. With very few exceptions, communities that need money for new or rebuilt services can obtain it cheaply—witness the R.F.C. sales prices of TWA bonds.

To continue the PWA is to give a few communities whose officials don't mind going to Washington pleading poverty an unfair advantage over those who wish to stand on their own feet. Further, the PWA has set up a system of federal control over local expenditure that is highly undesirable. Continuation of PWA over an indefinite period can but augment these unfavorable effects.

It is inevitable that the discontinuance of an agency like the PWA should work hardship on some of those who are employed by it, but this fact should not be permitted to block a move that in the end will create more employment than did the discontinued agency. The PWA with its offer of an outright grant of a large part of the cost of an undertaking serves as a check on the return to normal methods of financing municipal undertakings because city officials in many instances feel that they should explore the possibilities of PWA financing before undertaking financing through normal channels.

Congress has decreed that the PWA should be continued until June 30, 1939, but the funds that are available to it are so limited that it can do no more than take care of part of the applications now before it. Though this compromise still will give some cities an unfair advantage, it at least has the merit of ending the uncertainty for many other cities as to whether or not they should apply to the PWA for funds. Had there been a complete ending of all new financing by the PWA we believe that it would have resulted in the start of a large amount of work now held up by uncertainties and created employment for more engineers than would have been dropped by ending PWA.

Sewage Irrigation

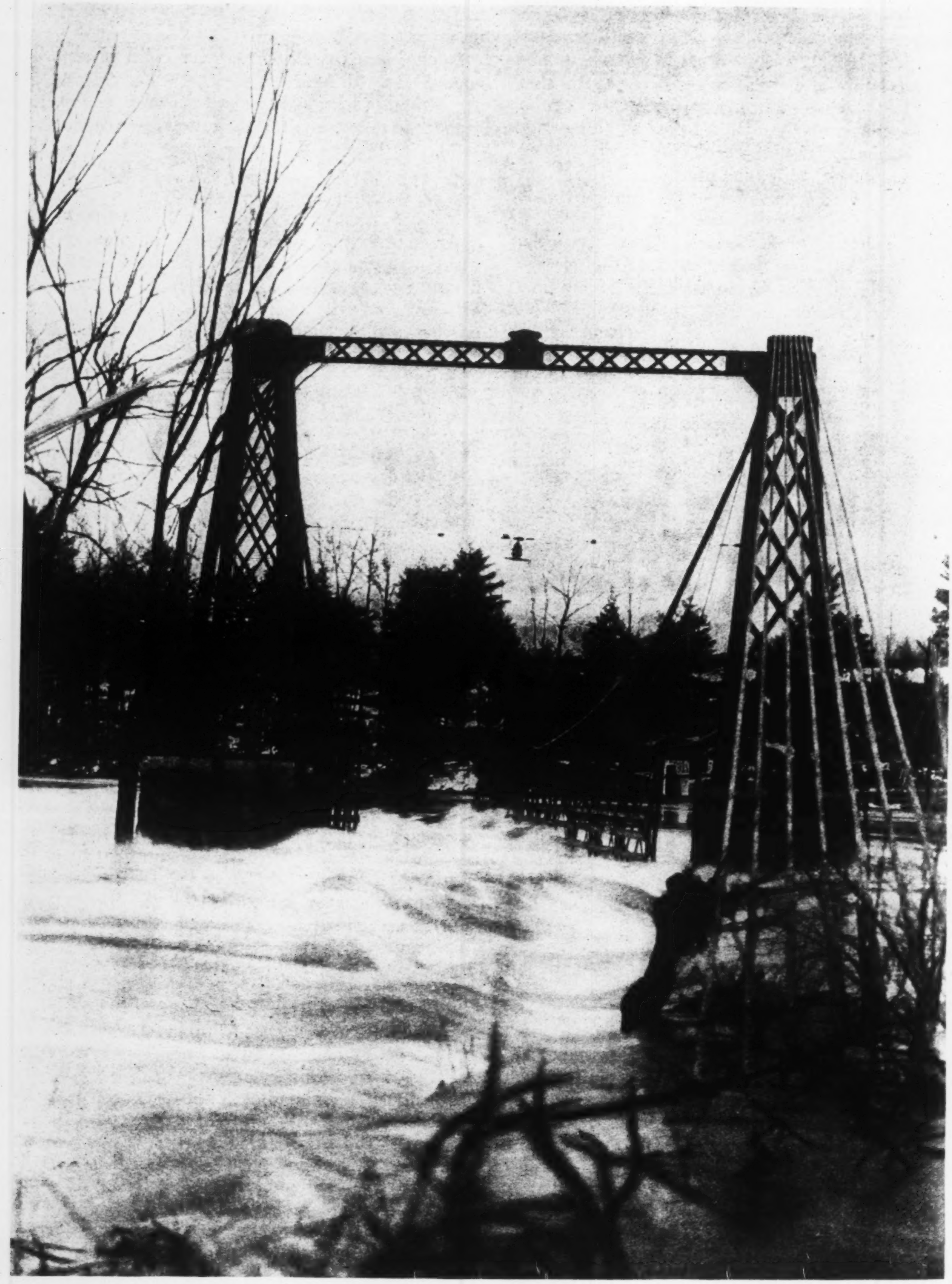
WHEN VINELAND, N. J., installed a municipal sewage irrigation scheme in 1930 it adopted the oldest method of treatment, one which is generally regarded as outmoded. That it nevertheless has great value is attested by the fact that the Vineland farm has provided adequate and low-cost disposal facilities for 8,000 people during the last seven years.

Experience abroad with sewage irrigation dates back several centuries. Most of the works have long been abandoned, but the farms at Paris and Berlin still remain as examples of major operating installations. In this country sewage farming was first used at Augusta, Me., in 1876; by 1935 there were 213 installations in the United States out of a total of 3,700 disposal plants.

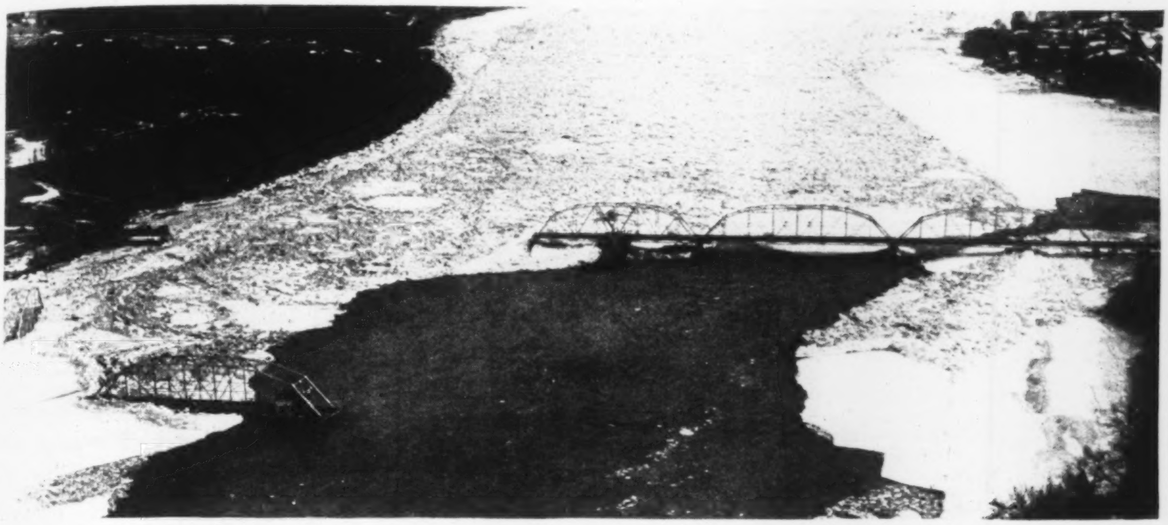
The abandonment of irrigation was due more to economic causes than to technical defects of the system. Large land areas are required to put the natural purification abilities of the soil to use, and such areas can not always be found. The popular prejudice against farm products irrigated by sewage is another adverse argument.

Interestingly enough, it was the shortcomings of land treatment that led to experiments in purification accelerated by artificial means. Thus it was that Dibdin, chief chemist to the London County Council, who had noted that porous soils gave best results, introduced "contact beds," using coarse rock and clinker media. It was but a step farther to the development of the trickling filter, widely used today and destined to become even more important in sewage treatment practice.

Special conditions at Vineland, as described elsewhere in this issue, made it possible to take advantage of past experience with sewage irrigation and to make a success of the method. But lacking these fortuitous circumstances the community would have had a wide choice of perfected treatment methods which themselves trace their origin to the principles active in land disposal.



WHY BRIDGE BUILDING follows floods. Record floodwaters of the Connecticut River pounding the east tower pier of the famous old Brattleboro suspension bridge just before it went out ending over a half-century of service. It is being replaced by a high-level steel arch.



ICE PACK ON CREST OF THE KENNEBEC FLOOD WRECKED THIS MODERN BRIDGE AT RICHMOND, MAINE

Bridge Building Follows Flood

By Waldo G. Bowman

Associate Editor, Engineering News-Record

New England states carry on a huge bridge replacement program that will give them modern structures in place of the obsolete bridges washed out last year

Throughout New England, highway departments of the states, cities and villages and the state WPA forces have had a busy time since the floods of March, 1936, swept out hundreds of their bridges and damaged many more. Faced first with the emergency task of getting the main routes open over temporary bridges or of opening damaged bridges after makeshift repairs, all of them discharged their responsibilities with speed and precision; motorists could get about comfortably in New England by June.

Then came the twin jobs of designing new structures or permanent repairs and of getting the money for the work. Here progress has varied, some states being considerably ahead of others; but in all states, getting the money and the permission to spend it has been the bottleneck. Today, fifteen months after the floods, the field work on many of the larger bridges that had to be let to contract is just nicely under way. Bridges built under force account by WPA have fared better, partly because they are simple and small structures, but also because money matters were more easily adjusted.

Mostly WPA money

Replacement of flood-damaged bridges in New England is a WPA-financed operation; all drawings bear the project symbol WPFR, meaning Works Progress Flood Replacement. In most of the states practically complete reliance is placed on federal money. An exception is New Hampshire, which authorized a two million dollar bond issue of its own to supplement WPA funds, and it has been able to use this to advantage in speeding up its work. Massachusetts also appropriated $450,000 which was used for temporary bridges and for repairs to crossings of the Connecticut River. Bridges built by force account under WPA, again except in New Hampshire, are almost wholly federally financed, contributions from towns and villages being nominal only. On the larger work let to contract, the state and local contribution averages about 25 per cent. The few new bridges required on federal-aid highways are being replaced by state and Bureau of Public Roads funds, under the provisions of the Hayden-Cartwright Act and no WPA money is involved.

Handling the flood replacement program is a joint effort. WPA builds the small structures by force account. Some of these are designed by WPA engineers, but the designs for the more difficult ones are obtained from the state highway departments. The bridges which are let to contract are handled like ordinary federal-aid work—that is, they are designed and their construction is handled by the state highway departments under the supervision of the U. S. Bureau of Public Roads—and WPA merely acts as fiscal agent in transferring the necessary funds to the Bureau.

Before considering some of the in-

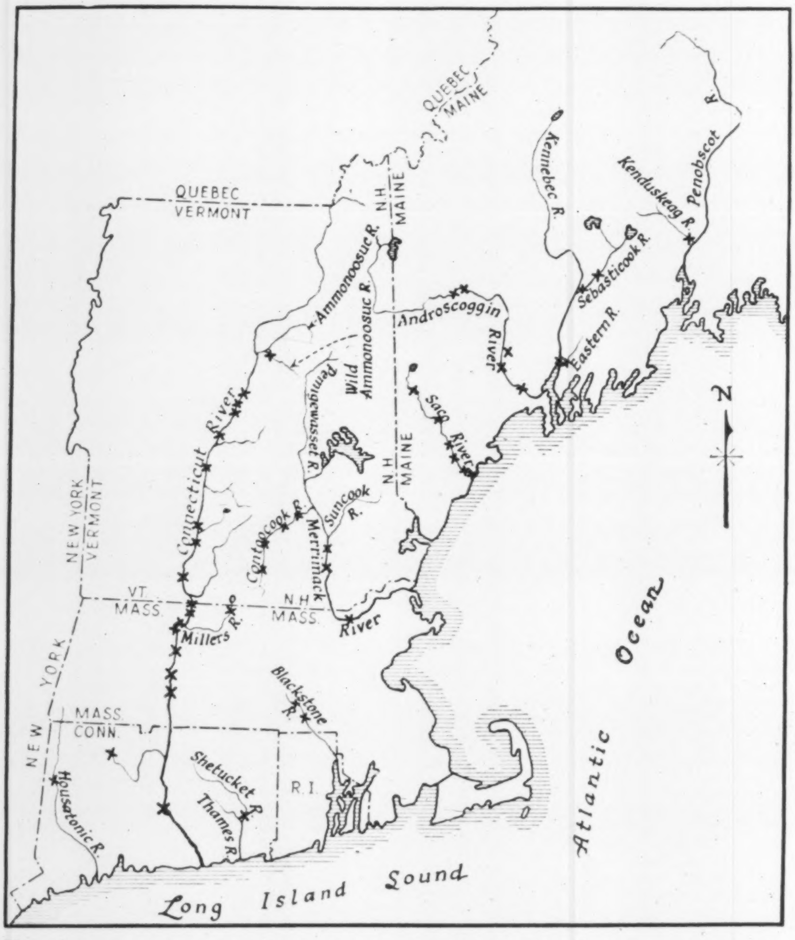

QUEBEC
MAINE
QUEBEC
VERMONT
N.H.
MAINE
Kennebec R.
Penobscot R.
Kenduskeag R.
Sebasticook R.
Eastern R.
Ammonoosuc R.
Wild Ammonoosuc R.
Androscoggin River
Pemigewasset R.
Saco River
Connecticut River
NEW YORK
VERMONT
N.H.
MAINE
N
Contoocook R.
Suncook R.
Merrimack
VT.
MASS.
N.H.
MASS.
River
Millers R.
Ocean
NEW YORK
Blackstone R.
MASS.
CONN.
Shetucket R.
Thames R.
R.I.
Housatonic R.
Atlantic
Long Island Sound

Fig. 1. The map of New England is dotted with bridge jobs as a result of last year's flood. Only the ones on the larger streams are indicated here.

BRIDGES BUILT BY CONTRACT AND HANDLED BY STATE HIGHWAY DEPARTMENTS AND BUREAU OF PUBLIC ROADS

	Maine	N. H.	Vt.	Mass.	Conn.
			Funds from Hayden-Cartwright Appropriations		
Number	1	7	3	1	0
Total Cost	$135,000	$180,000	$195,000	$1,450,000	0
Federal Share	65,000	100,000	100,000	725,000	0
			WPA Funds Transferred to BPR		
Number	29	22	4	59	24
Total Cost	$2,400,000	$935,000	$205,000	$4,150,000	$500,000
Federal Share	2,000,000	700,000	80,000	3,600,000	400,000

teresting facts about the flood replacement programs of the different states the answers to several questions may supply useful background. Why were so many bridges wrecked? What was the nature of the flood? What rivers did the damage?

The answer to the first question is part of the answer to the second. So many bridges were washed out or damaged because flood stages were higher than they ever had been before and because more ice was present than in any previous high water. The floods resulted from heavy rains on melting snows, a phenomenon which caused the main rivers to gain volume and velocity gradually, as tributaries progressively poured into them. Damage thus was greatest in the lower reaches of the main streams, in direct contrast to the flood in the fall of 1927, which was most destructive upstream since it was caused by rapid runoff at the headwaters when rains of cloudburst proportions fell on frozen ground. This difference in the nature of the floods may partly explain why Vermont, which bore the brunt of the 1927 flood, was least affected in 1936.

As to rivers which did the damage, the Connecticut, which runs due south from Canada to Long Island Sound, left its mark in New Hampshire, Massachusetts and Connecticut. The Merrimack affected New Hampshire and Massachusetts. And in Maine, the four large streams—Saco, Androscoggin, Kennebec and Penobscot, reading from west to east—were destructive in the order named. The large bridges that were lost were over these half dozen streams, as checked on the map of Fig. 1. It was their tributaries, however, that ran the toll of bridges destruction into the hundreds by riding roughshod over the smaller structures.

The damage in dollars

Since most of the bridges lost were old and obsolete, it is virtually impossible to use any estimate of their value as a measure of the damage done. A better yardstick is the cost of replacement. Although this measure too is inaccurate, because several of the large contract structures are not strictly "flood" bridges, it is the best available.

Starting first with the bridges let to contract, since there is less uncertainty about the reliability of the statistics for this part of the program, the accompanying table shows 12 bridges costing $1,960,000 (Hayden-Cartwright Act funds) and 138, costing $8,190,000 (WPA funds).

WPA force-account work costs are difficult to estimate, but a compromise of all figures obtainable indicates a $2,500,000 federal expenditure in the five states as follows: Maine, 150 bridges for a total of $1,300,000; Massachusetts, 119 bridges for $750,000; New Hampshire, 177 bridges for $450,000; Vermont, 16 bridges for $43,000; and Connecticut, 17 bridges for $75,000.

To the above expenditures New Hampshire adds its own money as follows: on WPA force-account structures, $450,000; on 17 new structures with no aid, $160,000; on repairs to 84 bridges with no aid, $400,000; and on 14 temporary bridges with no aid, $100,000. Or a total of about $1,000,000.

Thus, over $13,000,000 is being spent on bridge work in New England, of which about $10,000,000 is directly chargeable to the floods; the remainder is for work at locations where bridges did not go out but where it was demonstrated that new structures are needed. The bridges cover a range from culverts to 425-ft. steel arch spans and long continuous trusses. The reason why they are necessary lies in the nature of the damage that each state suffered, which will be reviewed in the light of the larger contract structures since in them rest most of the lessons of engineering significance.

Nature of the damage

In Connecticut the damage to bridges was about equally divided between town bridges and state highway structures, with the result that the $500,000 contract program includes new state bridges and 12 town bridges. In addition, 17 force account bridges have been built at a cost of $43,000.

All except one of the 24 contract bridges are small or medium sized structures, ranging in cost from $1,700 to $30,000. The single large bridge job (requiring a $156,550 expenditure) is at Norwich, on the Shetucket River, where undermining of a pier common to two 125-ft. trusses dropped them into the water. At Kent, on the Housatonic, a $50,000 expenditure will be required to replace a 150-ft. truss span that was floated off its foundations and wrecked, but the bridge is not in the present program. Of the 12 state bridges, 9 are complete and 3 under construction. Of the 12 town bridges, 11 are under construction and bids are called on the last one.

The majority of bridge losses in Connecticut were connected with the failure of old dams on the small streams. The most spectacular and widely publicized of these failures was at New Hartford, on a tributary of the Connecticut River, where an old timber dam about 20 ft. high washed out, releasing a deluge of water and debris that wrecked the

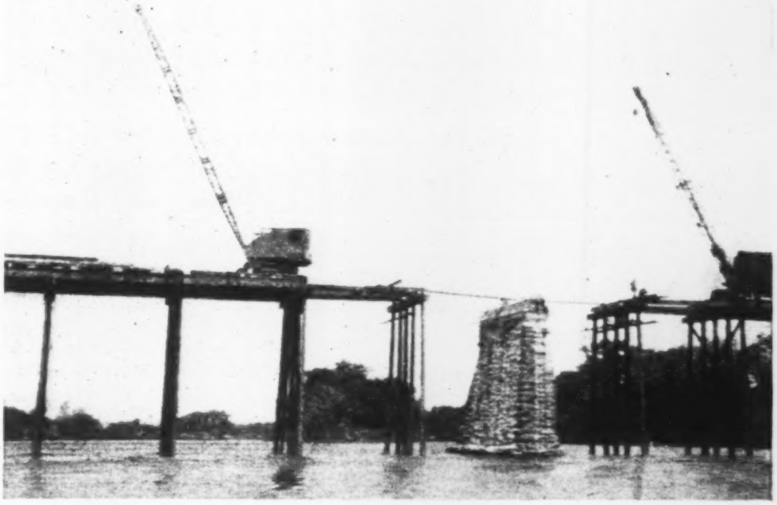


Fig. 2. By virtue of temporary bridges travelers could get about in New England soon after the flood. This bridge, over the Connecticut at Sunderland, Mass., makes use of the old piers.

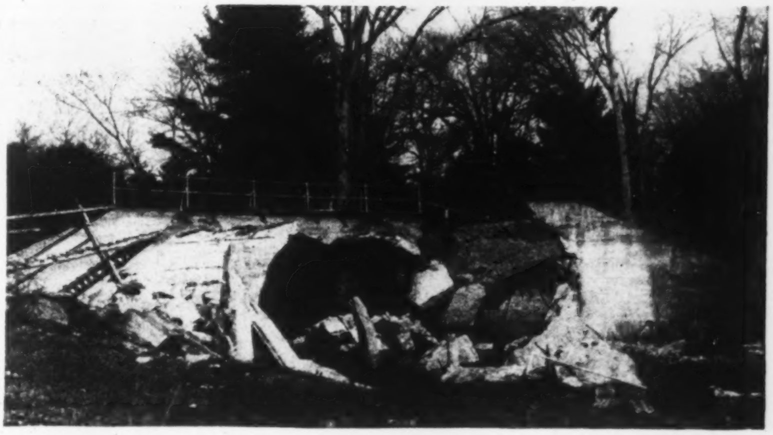


Fig. 3. What the Millers River in Massachusetts and its battering ram of debris did to a concrete arch bridge.

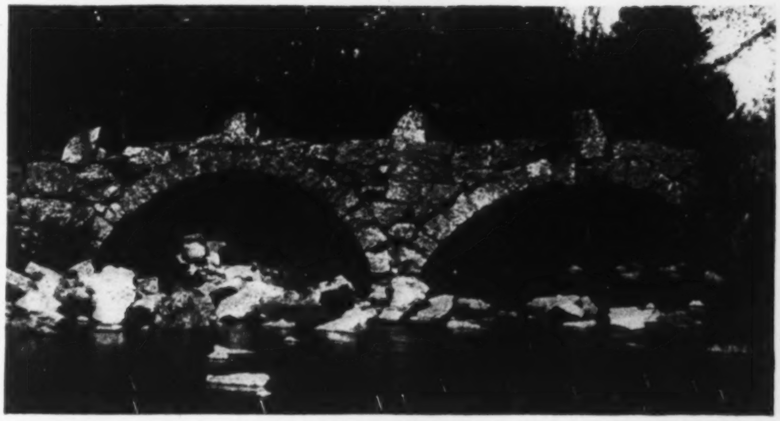


Fig. 4. A phenomenon of the floods was the stability of dry stone arches whose porous construction reduces the water pressure against them.

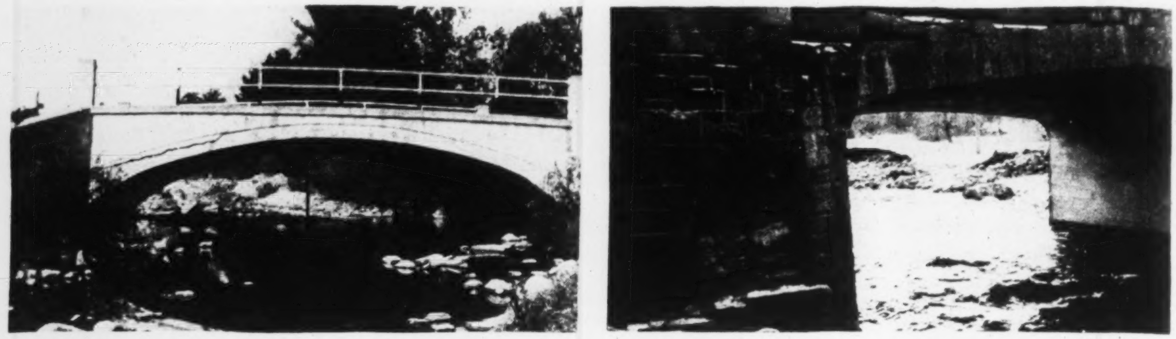


Fig. 5. Abutment settlement was a major source of damage in New Hampshire. The concrete arch (left) was cracked beyond economical repair. The concrete rigid frame (right) was not damaged although one end dropped 18 in.

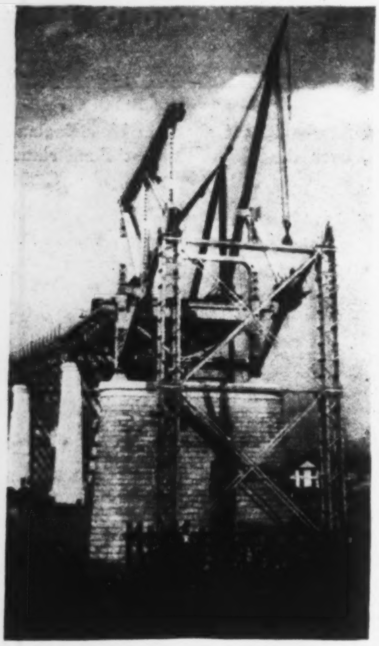


Fig. 6. New bridges, such as this 600-ft. tied arch at Middletown, Conn., are placed above the 1936 flood mark.

125 ft. steel truss span in the village, just downstream. Most of these old dams were a constant menace, and their removal is another benefit that can be credited to the flood.

Damage in Massachusetts

In Massachusetts, practically every stream in the state was affected, and bridge damage was particularly extensive on the Connecticut, its tributary the Millers River in the northern part of the state, and on the small Blackstone River in the southern part of the state. The Merrimack River, the other principal stream, damaged bridges at Lowell but took none of them out.

As in Connecticut, the greatest single cause of bridge damage, excluding structures on the large streams, was dam failures. For the most part these were old, abandoned dams whose dependent industries had either vanished or turned their dependence to purchased electricity. The second major cause of bridge damage was old age. Of the 60 new bridges let to contract in the federal-state program, only two replace structures that were less than 40 years old. With a few exceptions all modern bridges successfully withstood the flood waters and the battering of ice and debris.

New Hampshire losses

Highway bridge losses in New Hampshire were particularly severe. The Connecticut and the Merrimack are the major streams of the state, and on them and on the Contoocook, a Merrimack tributary, occurred the major damage, although a dozen other small streams contributed to the total bridge loss of some $2,500,000. Another fact is that most damage occurred in the south half of the state, below the White Mountains. This was a result of the nature of the flood, which originated in the melting of 4 ft. of snow in the mountains and upper Connecticut River valley; as the Connecticut and the Merrimack gathered volume and velocity from each tributary they became increasingly destructive, their floating ice forming a powerful battering and scouring agent. Bridge loss as measured by replacement costs on the Connecticut River alone was $1,000,000 in New Hampshire.

Dam failures, if as numerous as in Massachusetts, were not as destructive of bridges. However, the failures were similar to the extent that the majority of them involved old structures located in villages or on secondary roads. The only modern bridge that was severely damaged was a 9-year old 120-ft. steel truss near Woodsville, whose abutment washed out, although a half dozen small concrete arch and girder bridges whose age was not over 15 years suffered a similar fate. Of the 29 contract bridges in New Hampshire, 7 are complete, 7 have not been started, and 15 are under construction.

More large bridges were lost in Maine than in any of the other states. Probably several causes were responsible, among them the facts that Maine has four large rivers of high-velocity characteristics and that these streams, the Saco, Androscoggin, Kennebec and Penobscot, carried heavy accumulations of ice which went out on the crest of the flood. Bridge loss on the four rivers decreased from west to east, and damage was confined to the lower reaches of the streams. To replace the large structures 30 new bridges to cost $2,500,000 are under contract.

Only one modern bridge was lost in Maine, a five-span through truss structure at Richmond on the Kennebec. In this case a record-breaking ice pack 25 ft. thick and extending 5 miles up the river moved sideways under the bridge, wrecking three of the five piers and dropping three 200-ft. spans into the river. All of the other structures lost were old and obsolete.

What the flood taught

Because so many of the bridges lost had obvious weaknesses and were not of modern construction, the

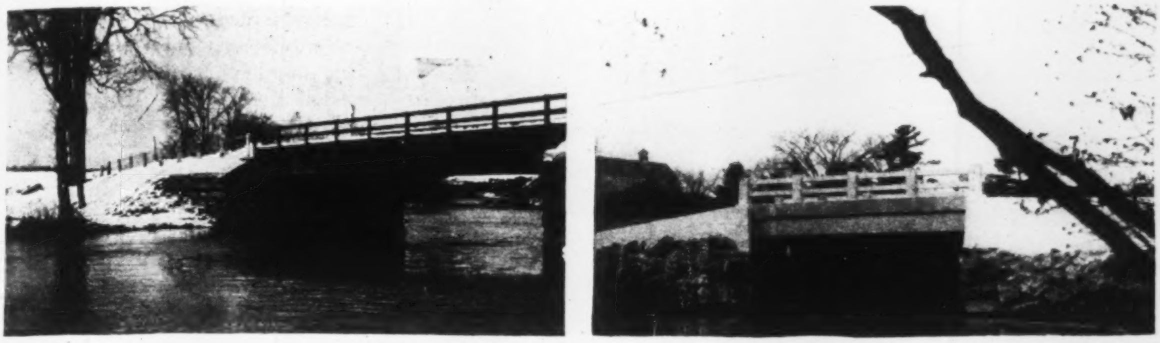


Fig. 8. **Typical examples of WPA force account construction in Maine. Left, rolled girder beams on stone-filled timber crib abutments. Right, concrete T-beam bridge on old stone abutments.**

lessons from their failure are naturally restricted in scope. Yet some interesting and suggestive occurrences serve to emphasize both good and bad practices.

Foundation failure from scour was common on the bridges lost in the state of Connecticut, a direct result of the numerous dam failures that released large volumes of water at high velocity. Where old dams exist above bridge locations, scour would seem to be a hazard to recognize.

The disadvantage of timber decks was emphasized in nearly all of the failures in Connecticut. Such decks are not heavy enough to contribute needed weight, and if they are well tied down they contribute buoyancy to the superstructure. L. G. Sumner, engineer of bridges and structures of the Connecticut state highway department, cites the case of the old Connecticut River bridge at Middletown, which was subjected to uplift from water and debris but did not go out. Several years ago its timber stringers were replaced with steel stringers and, although the timber deck was retained, the steel stringers contributed just enough weight to keep the spans on the piers.

Deeper footings needed

In Massachusetts, also, the prime lesson taught by the flood was the necessity for placing foundation footings below scour depth. The warning applies more to abutments than to stream piers, in the opinion of George E. Harkness, state bridge engineer, for in few cases were piers undermined. On the contrary, when the thread of the current happened to hit the piers at a slight skew, eddies were created that built up deposits of sediment around the pier bases. Concurrently, however, scour occurred from the same eddies at varying distances either side of such piers, and in the case of short-span bridges these scoured holes often extended to the abutments. Currents directed toward shore found easy marks on abutment wing walls, took out approach fill behind the abutments, and in general undermined and weakened them. Abutments, therefore, should go deeper and be protected both by riprap and by careful control of current direction through training works. Since exposed concrete piers were severely damaged by debris whereas granite-faced piers came through the flood with hardly a mark, a more general use of stone facing might prove profitable

Superstructure resistance

Bridge span anchorages also showed weakness. High velocities tend to tip the spans over, and ice and debris accentuate the tendency. Recognizing that conventional anchor bolts may not provide sufficient anchorage, Massachusetts, on two new Connecticut River bridges, is putting in more positive tie-downs. These consist of turnbuckle bars extending from a grillage buried in the pier to connections with both the top and bottom chords, and on one of the bridges a horizontal bar member connected between the pier and the bottom chord is also used to resist lateral movement of the bridge. Such anchoring systems, costing $2,000 to $3,000 on a half-million dollar bridge, are held to constitute cheap insurance.

More rugged bridge superstructures, of course, will have greater resistance to debris and ice. Massachusetts engineers feel that ruggedness is best increased by a strong lateral system in the plane of the lower chord or deck. The floorbeams, which act as columns under horizontal loads, benefit particularly from excess strength. Just how heavy the lateral system should be is a matter for engineering judgment, but considering that 15- or 20-ton ice cakes may strike a bridge when traveling from 6 to 10 miles per hour it is evident that liberal allowances are not out of place.

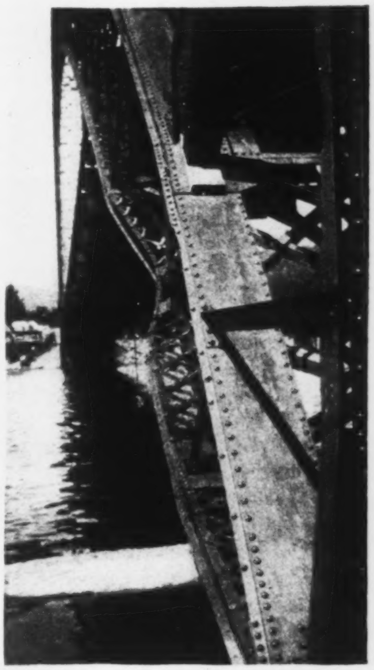


Fig. 7. **A close call for a 540-ft. span steel arch over the Connecticut River at Bellows Falls. Ice put the kink in the bottom chord.**

The flood in New Hampshire also emphasized bridge lessons, some peculiar to the locality, others of nationwide application. Pin-connected trusses are easily knocked down by ice, whereas modern riveted trusses can take severe punishment. The flood did away with many of the famous pin-connected lenticular or "pumpkin seed" trusses. Riveted trusses, on the other hand, still stood even when their lower chords were bent between panel points until they resembled scalloped members or until their verticals were bent and diagonals broken. In most cases the joint rivets were not torn out. The most spectacular case was that of a 540-ft. steel arch, whose arch rib was bent over a foot out of line by the ice, and no collapse occurred.

Saving stone bridges

New Hampshire has a great many ancient dry stone arch bridges of one or two spans, and while a large number of these were washed out many withstood high water in astonishing manner. Such bridges are little damaged even by considerable settlement, since the arch ring, being loosely fitted together adjusts itself to a new pressure line. Also, the essential porousness of the structure is believed to be an element of great strength, since pressure does not build up against the arches or piers as it does with solid structures. However, even if modern bridge building demands could justify their use, such dry stone structures could not be built widely because the art of laying them up has been lost. A method of saving these old arches from destruction by installing a reinforced concrete inner structure and pointing the existing stone has been developed and utilized by J. W. Childs, bridge engineer of New Hampshire. Two such bridges withstood the flood successfully.

Concrete decks on light steel trusses proved effective in resisting ice impact and buoyancy when timber-decked structures washed off. Several famous old timber bridges were floated off or tipped over, but only after taking heavy punishment from the ice and debris that was dammed up by their covered sides. The high degree of indeterminacy caused by the multiple intersections of the web members of these old trusses has been criticized, but these same multiple intersections furnished enough extra stress paths to the top chords to hold up the bridge even after bottom chords were broken and some of the web members torn out. While this inherent extra resistance may not be advantage enough to recommend such trusses for present-day service, it helps to explain the long life of the old timber bridges throughout New England.

Foundation settlement was a potent cause of damage, being particularly destructive to concrete slab and girder bridges and concrete arches, as shown in some of the illustrations. Abutments in New Hampshire as in Massachusetts were more prone to failure than piers. Mr. Childs suggests placing abutment footings deeper than ordinary caution would dictate, and in important cases founding them on piles protected by sheeting front and rear. If abutments are thus made stable, wing walls need not be extended very deep, and if water gets behind them and washes out the approach fill, no great damage will occur to the bridge. Such a washout might, in fact, be planned for, so that the greater waterway would relieve the pressure on the bridge.

Rigid structures favored

On culverts and short-span girder bridges in New Hampshire, inverts integral with the abutments and built with upstream and downstream cutoff walls justified themselves. No bridge built to this design failed or washed out. A year or two ago the state began the practice of using rigid-frame bridges in replacing many of the old stone arch structures. This decision was also upheld in the floods when these modern bridges provided the necessary increased waterway. Also, the strength of the concrete frame was demonstrated in one instance when the foundations at one end of a new 60-ft. span bridge washed out, dropping the structure about 18 in. The only visible damage was the opening of a few small cracks at the haunch, and after the bridge had been jacked back to its original position and a new foundation installed these cracks closed up.

Ice hazards in Maine

Maine's bridge losses were represented by a large number of old structures of major size, most of them light steel trusses with timber floors. All were founded on masonry foundations, and failure was about equally divided between foundation washout or scour and tipping of the superstructure. Ice flows were the principal destructive agent, so that the lessons learned in Maine have particular application to the problem of impact.

Pier scour and failure was more common in Maine than abutment damage, in contrast to the experience in Massachusetts and New Hampshire. This may have been due to the presence of much heavier ice. Also, when the ice extended entirely across a stream it was often below the level of the abutments, which thus were protected from the swiftly running water beneath, which found a fair target in the piers. Numerous piers were washed out, others settled, and in a number of instances piles were left exposed without lateral support.

Concrete bridges in Maine stood up well. Most of these had T-beam decks, although steel beam spans with concrete decks were also effective in resisting the ice pressure. The design of such structures would not be changed, according to Max L. Wilder, state bridge engineer. Concrete piers, however, will probably henceforth be reinforced, after the experince with the Richmond bridge, whose five-year-old unreinforced piers were broken in two, tipped over and badly cracked when an ice jam moved sideways against them. Finally, the flood in Maine demonstrated the advantages of placing superstructures above extreme high-water levels whenever possible, and also giving the superstructures as much weight as is economically justified.

Conclusion

A good many of the lessons in better bridge building emphasized by the failures in the New England states are being applied to the replacement bridges. Vertical clearances of the larger structures, at the insistence of the Bureau of Public Roads, are extended above the record flood stages. Longer spans are also encouraged, in the interest of greater discharge capacity between piers. Foundations go deeper, and usually much deeper, since they replace old timber cribs that were merely sunk into the mud by the weight of the stones in and on them. More positive anchorage of superstructure to substructure is a definite objective of design. And in construction and framing details, of course, the new structures incorporate modern practice fully.

A picture of what is being done in the way of major new bridges and interesting and intricate repairs on the larger structures may be had by a trip up and down the major river valleys. Such a trip will be described in an article in next week's issue.

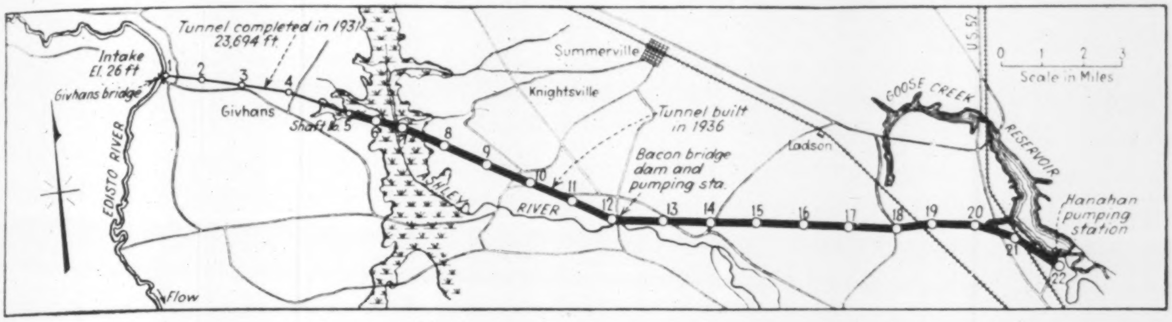


FIG. 1. A TUNNEL OVER TWENTY-THREE MILES LONG BRINGS A NEW SUPPLY OF WATER TO CHARLESTON, S. C.

Fast Tunneling Clinches Sale of Water

Charleston, S. C., working 1,000 men night and day drives a 7-ft. tunnel 18½ mi. between August and May to meet a sudden call for water by a large industry

A tunnel 18.6 mi. long completed in seven months is something to talk about in tunnel construction even though one comes to find it less astonishing when all the conditions are known. This tunnel has just been completed to provide additional water supply for Charleston, S. C. As a water-works improvement its best measure perhaps is that it gives this famous old southern city 50,000,000 gal. more water daily (which can be boosted to about 80,000,000 gal. by pumping) and that it has cost the city less than $1,000,000 and at the same time secured for it a profitable contract for supplying water.

Charleston has been adding progressively to its water-supply system since about 1850; neglecting the intervening history, the city in 1917 was getting its main supply from works purchased from a private company that has as their principal elements Goose Creek Reservoir and Hanahan pumping station about 12 mi. north of the city. Then, largely as the result of war demand for more water, a canal-and-pipe aqueduct was constructed west from Goose Creek Reservoir to tap Ashley River, which was dammed at Bacon's Bridge, and a pumping station was built. This work was completed in 1919 but was not used until 1927 when the great drought made it necessary.

The drought also proved Ashley River to be a very unsure source of supply and prompted the city water officials to look farther west to the Edisto River. As the result, it was decided to build a 4½-mi. tunnel aqueduct from the Edisto to the nearest branch of the Ashley about 10 mi. above Bacon's Bridge dam: the water, it was the plan, would go through the tunnel and down the Ashley to the dam and thence by the existing pipe-and-canal aqueduct to Goose Creek Reservoir. That tunnel was begun in January 1928, completed a year later and put in operation in 1931. The new tunnel is a continuation of the old one. (Fig. 1.)

The construction of the new tunnel was not prompted by the immediate city need for water but by a proposal by the West Virginia Pulp & Paper Co., to locate a new mill at Charleston if the city would guarantee a water supply. This was an opportunity to secure both an industry and a large buyer of water. In June 1936 the city entered into contract to supply the paper company a minimum of 25,000,000 gal. a day, issued bonds for $1,000,000, and began the construction of the new tunnel from the end of the old tunnel on Ashley River 18.6 mi. to Hanahan pumping station at the Goose Creek Reservoir.

The ground through which the tunnel runs consists of a mixed material overlying a bed of marl—virtually a soft calcareous rock containing about 17 per cent moisture and very homogenous. This marl bed crests at varying elevations and outcrops in places. In general the cover is from 40 to 60 ft. with a minimum of 20 ft. At places the surface conditions are bad due to swamp. The first 4½-mi. tunnel had been built unlined through this marl and before the new tunnel was started it was decided to learn how the old tunnel had stood up. Unwatering showed that almost no deterioration had occurred after 8 years under water; instead the surface of the marl seemed to have hardened, so it was decided to build the new tunnel without lining.

The same section (a 7-ft. diameter modified horseshoe of about 40½ sq. ft. area) as the old tunnel was adopted. At the Edisto intake the elevation is 26 ft. and the flow line of Goose Creek Reservoir is at El. 7 so that the fall in 23½ mi. is 19 ft. This grade and section is expected to give a gravity flow of 50,000,000 gal. daily, which can be increased to over 75,000,000 gal. by pumping. For drainage during construction the tunnel was not given a uniform grade; instead the bottom is a succession of rises and falls having crests between shafts and valleys at shafts.

The agreement with the paper company (June 1936) anticipated water supply to the new mill by July 1,

1937. Fast construction was necessary. It was therefore decided to dig the tunnel from 17 shafts and 2 portals; force account construction was also decided on, and work began on a basis of two 10-hr. shifts per day and a 6-day week with Sunday devoted to servicing and repairing equipment. Incidentally, before any construction, right-of-way above the tunnel wide enough for all surface operation was purchased. An account of the tunneling conditions and methods is given below.

Marl Tunneling Methods

by J. E. Gibson

Manager and Engineer, Water Department, Charleston, S. C.

When we speak of tunnel construction we usually think of a mountainous section, and when one begins to talk about driving a tunnel in low country where the average elevation above sea level probably does not exceed 60 ft., and in many places is only 25 or 30 ft., it may look as if a tunnel was a crazy idea. The very sound reason, however, is that for 23 mi. we had a marl formation, starting on the Edisto River on the west and extending eastward to the Cooper River, and in this entire 23 mi. no evidence of falls, slips or cracks was found. When we first began to consider the project back in 1928, we were apprehensive that the earthquake of 1886 might have shaken this marl up pretty badly, but my investigations preliminary to driving the tunnel and the observations made in driving the first section, convinced me that the earthquake of 1886 had no effect on this underlying stratum, and that the surface movements which caused so much trouble and of which the papers talked so much, were the slipping of the overburden along the plane of the marl.

There was some change in the texture of the marl. In some places it was quite hard, approaching closely the hardness of limestone, and having an analysis of probably as high as 88 per cent calcium carbonate; at other places it was a much softer material, readily cut with a knife or chisel and having a calcium carbonate content running as low as 45 per cent. There was some change in color but generally speaking the material had a dark gray color. The moisture content was about 17 per cent. The iron content was very low, and the silica content ran around 10 per cent but as high as 28 per cent. There was a small percentage of phosphorus and magnesium. The principal ingredients were calcium and silica. The interstices were very small, and capillary in size.

Progress was rapid

The progress made was very exceptional even when one considers the nature of the material through which the tunnel is driven. The work of assembling the equipment and personnel did not begin until June 1, 1936, and there were seventeen shafts to be sunk, besides driving the tunnel from two headings from each shaft except No. 6 and No. 22. The best week's progress was made the first week in January when 7,032 ft. of tunnel were driven. After that the progress slowed down because some of the headings had met and the number of men driving the tunnel was thereby reduced. The final heading was driven through on Feb. 24, 1937 so that the 98,000 ft. of tunnel were driven, including the sinking of the shafts and the final holing through of the last section, in nine months. The time, however, for actually tunneling the 98,000 ft. was a little over seven months as we did not manage to start actual tunneling until about Aug. 1, 1936.

One of the principal difficulties was the territory through which the tunnel was driven. A large portion of the 18 miles was in low swampy land, some of it being just about tidal elevation or below, and subject to overflow due to the low gradient. The roads were the ordinary country roads, and in one or two instances we had to build corduroy roads, and in hauling the equipment in and out it was pretty hard to keep these roads up, considering that the soil on which we had to build them was low, peaty, swamp humus. For instance, between shafts No. 7 and No. 6, the distance through the swamp was 4,800 ft., but to go from Shaft 7 to Shaft 6 by truck or automobile required, when the roads were in the best condition during the dry season of the year, a

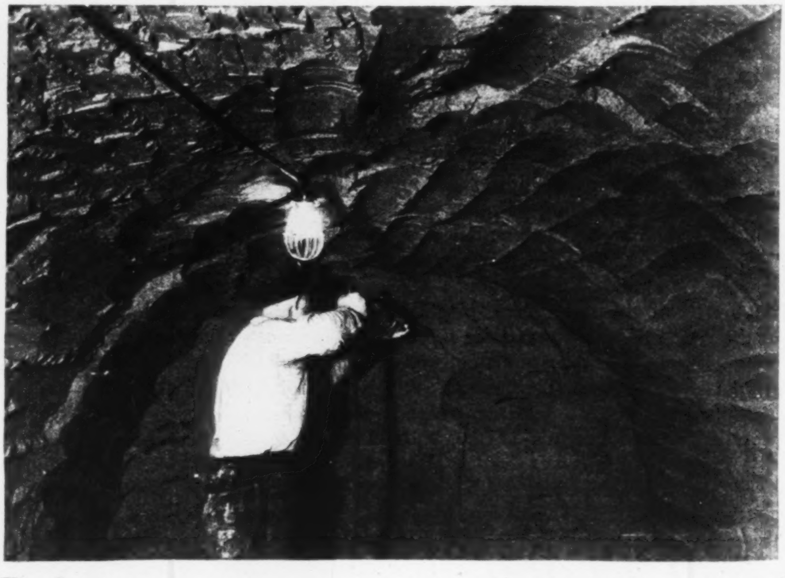


Fig. 2. A tunnel in marl was excavated by air spades and light blasting at a speed of 2.3 mi. a month to increase the water supply of Charleston, S. C.

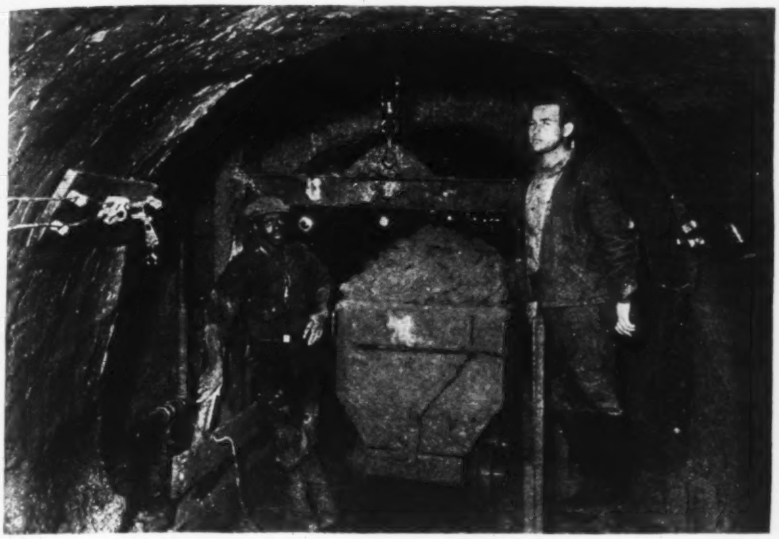


Fig. 3. Men in relays 800 ft. apart pushed the muck cars to the cages of 17 hoist shafts averaging a mile apart on the Charleston water tunnel.

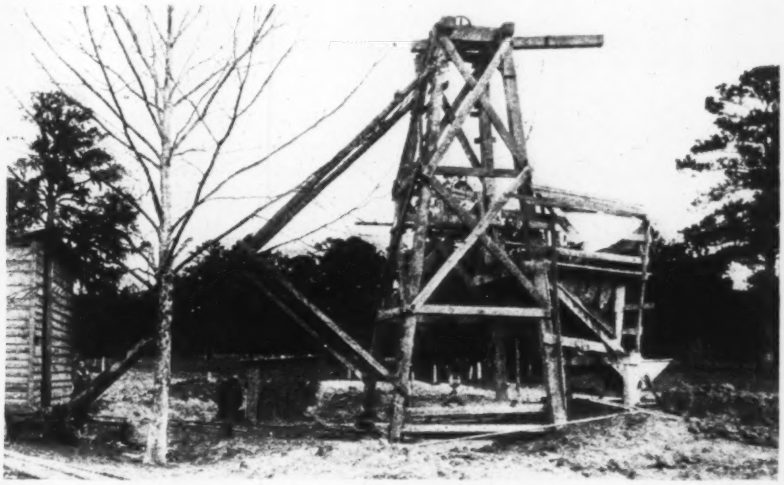


Fig. 4. Bolted timber head frames at each of the 17 shafts of the Charleston water tunnel were quickly erected and removed for the short eight months use.

trip of 15 mi.; after the winter months came on, the heavy rainfall combining with the reconstruction of a portion of these roads by the state highway department, made it necessary to make a trip of 35 mi. To cover the entire field of operations required traveling some 75 or 80 mi. every day over some very poor roads, and in many instances it was necessary to carry fuel for the engines in small containers by team and even on horseback.

Shaft sinking

As stated, tunnel driving was begun at 17 shafts and 2 portals. The main problem was to sink the shafts through the overburden of soil, swamp muck, clay and sand, down into the marl after which the difficulties so far as sinking was concerned were over, as the marl is impervious. Two methods were used in sinking the shafts: One was to drive sheeting and make excavation in the open, the sheeting being driven to the marl, and this was the way most of the shafts were sunk, particularly where the overburden was relatively shallow; the other method was to sink a caisson, a steel shoe being built up for cutting edge and a section of concrete poured and the caisson weighted, and the material then excavated just in advance of the cutting edge and hoisted to the surface. The caisson method was generally very satisfactory, but in one instance we had some difficulty when a sand stratum of very fine and round grains was encountered carrying considerable water, with the result that the shaft got out of plumb and the overburden caved around the shaft and washed in. This was overcome later by sheeting on the outside and also by adding weight.

At each shaft site there were erected a 220-cu. ft. capacity oil or gasoline engine-driven compressor on skids; a single-drum gasoline driven hoisting engine; a small 5-kw. gasoline 110-volt lighting unit; storage tanks for oil and gasoline, and, over the shaft, a four-post tower in which an elevator cage was rigged.

The muck was removed in industrial mine cars of about 20 cu. ft. capacity, fitted with roller bearings and running on a light industrial rail with steel ties. These muck cars were pushed directly on to the elevator cage and hoisted to the surface, run out on an overhead trestle work and dumped. Man power was used in pushing the muck cars between headings. The tunnel had an ascending grade of 0.2 per cent so that if the track was kept up in good shape the pusher on the muck car had no difficulty with cars loaded to heaped-up capacity. The 0.2 per cent grade also permitted any seepage water in the tunnel proper to flow back to the shaft where a small pump lifted it to the surface; this seepage amounted to less than ½ gal. per lin. ft. of tunnel per 24 hours, the wetted perimeter of the tunnel being about 23 ft.

Air was piped down the shafts from the compressors through 2-in. standard wrought steel pipe extended in each direction. The 220 cu. ft. compressor proved amply large for all purposes.

Driving tunnel

Tunneling was done by blasting, there being usually five holes in the 7-ft. diameter heading. The holes were drilled with fish-tail-type auger bits, to a depth of about 5 ft., four holes being spaced radially around the circumference, with an inclination toward the center of the section, and one center hole driven in horizontally, so that at the back or the base the four holes formed a circle about 3½ ft. in diameter around the center hole. The charges were tamped very lightly as it was found that less difficulty was experienced with the products of combustion by this method than by tamping the charges hard. All charges were fired by dry cell battery and the mass was lifted forward into the tunnel about 3 to 4 ft. The larger pieces were broken up with pneumatic spades and then the section was trimmed to within a few inches of full size by pneumatic spades. The final trimming of the tunnel was done by hand, using a carpenter's adz, with about a 4-in. blade and with the curvature increased slightly so as to enable workmen standing on the floor to trim from overhead down each side to floor. By this means a smooth-surfaced uniform section was obtained

At distances of 600 to 800 ft. sidings were placed in the tunnel for passing the loaded and empty muck cars, and the pushers were in relays so that each man pushed a loaded car only 700 or 800 ft., where he met his relay returning with an empty car.

The tunnel was completed April 28, 1937. Robert E. Parker, New York, was general superintendent of construction and had full charge of laying out and organizing plant and personnel. Francis B. McDowell, Jr., assistant manager and engineer of the Commissioners of Public Works, Charleston, had charge of all field work. Richard E. Mynatt of Mr. Parker's force was executive manager of the field office, Summerville, S. C., and J. E. Gibson, manager and engineer of the water department, had general charge of the entire undertaking for for the Commissioners of Public Works of Charleston.

Stack Handles Nitric Fumes

Corrosion resistance provided by stainless steel plates fabricated by gas welding with a stainless rod containing columbium

The first practical installation of stainless steel fabricated by oxyacetylene welding with columbium-bearing stainless steel welding rod has now given three years of service under severely corrosive conditions. Included in the installation is a stack 50 ft. high and 19¼ in. in diam. and some 15-in. piping, both of which handle gases containing high concentrations of nitric oxide at temperatures ranging between 570 and 750 deg. F. When the piping, of 10-ga., 18-8 stainless steel sheet, was installed, stabilized stainless steel and columbium-bearing welding rods were not available, but when later some 16 ft. of test welds were made in the piping using columbium-bearing rod and when five monthly inspections resulted in encouraging reports, it was decided to employ the columbium-bearing stainless steel welding rod in the fabrication of a new stainless steel exhaust stack.

The material specified for the exhaust stack was 10 ga., low-carbon 18 per cent chromium, 8 per cent nickel steel sheets containing titanium as a stabilizer. Stabilized stainless steel was specified to eliminate any tendency toward intergranular corrosion, which had been observed in a few cases in regions adjacent to the welds in the plain stainless steel piping of the original installation. Five flanged sections, each 10 ft. long, and bolted together at angle flanges on the ends, compose the 50 ft. length of the stack. Each of these 10 ft. sections is made of two pieces of 5x5-ft. stainless steel material formed into 19½-in. inside diameter rolls. The longitudinal seams are welded, and the resulting cylinders joined into 10-ft. lengths by means of circumferential butt welds, using columbium-bearing stainless steel rod with a special stainless steel flux. The flanges are attached to the sections by continuous welds and similar joints are used at the connection to exhauster inside the building.

Fig. 1. **Stainless steel stack 50 ft. high whose 125 ft. of joints were made by oxy-acetylene welding using columbium-bearing stainless steel rod.**

Although the stainless steel exhaust stack was placed in service without heat-treatment after welding, there have been no signs of corrosion and no cracking of the welds or metal adjacent to the welds during the more than two years it has been in service.

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New Weather Stations In Muskingum Valley

In an effort to establish the relation between rainfall and soil erosion, the Soil Conservation Service has established about 500 weather observation stations in the watershed of the Muskingum River in Ohio. Working in cooperation with the Weather Bureau, the Ohio WPA and the Muskingum Watershed Conservancy District, the Service has set up the stations in an area of 8,000 sq.mi. extending over 22 counties.

Located about four miles apart, the stations are manned by farmers from the relief rolls who have received training in reading weather recording instruments. Readings are taken every half hour from 7 a.m. to 7 p.m. The data is compiled at New Philadelphia, Ohio.

Municipal Sewage Irrigation

by George A. Mitchell

Manager, Vineland, N. J., Sewage Farm

A sewage irrigation farm scheme at Vineland, N. J. since 1928 provides disposal facilities for 8,000 people and aids crop production in poor soil

Following the abandonment of an overloaded sand filter sewage treatment plant in 1928, Vineland, N. J., a community of 8,000 people, adopted sewage irrigation farming as a means of disposal. This decision was influenced in part by successful use of this scheme at nearby state institutions where it had been employed for many years. The soil at Vineland, which is near Philadelphia, is a sterile coarse sand well adapted for drainage but not suited to farming unless irrigated and fertilized. Conditions are ideal, therefore, for sewage disposal combined with farming. In the following article Mr. Mitchell outlines experiences at the Vineland sewage farm during the past nine years. Other articles on sewage irrigation by the same author were published in ENR issues of Feb. 14, 1924, p. 284; Jan. 9, 1930, p. 65; Jan. 8, 1931, p. 66, and July 6, 1931, p. 57. —Editor

Sewage disposal by land irrigation on farms where crops are grown has been successfully practiced for more than two decades at several public institutions in New Jersey and for the past 9 years at Vineland, N. J., a municipality of 8,000 population. In the latter place much experimental work has been done in connection with the practical application of sewage irrigation and farming and the results have been highly gratifying. This article is intended as a summary of findings and a description of operating methods.

Perhaps the chief cause of failure of many sewage irrigation schemes in the past may be laid to slipshod methods and lack of proper attention. Too often the opinion has prevailed that if the effluent from a settling tank is spread on land it will take care of itself. While it is true that there is probably no better purifier of sewage effluent than a suitable soil, it is also true that certain necessary attention must be given to the method of conducting such disposal or else unsatisfactory results will follow just as they will from carelessness in connection with any other method of disposal. Most of the essential care needed, however, is little more than that required for producing useful farm crops at the same time.

Adoption by municipality

The study of possibilities of sewage irrigation of crops with Vineland sewage was undertaken by the writer and engineers of the U. S. Department of Agriculture at intervals during the 10 years preceding the adoption of this method in 1928. The municipality at that time was treating its sewage in a sand filter plant which was overloaded and a source of much nuisance. The decision by the Vineland borough officials concerning sewage irrigation was strongly influenced by the success of similar installations at a nearby state training school and at other places in New Jersey (*ENR*, Feb. 14, 1924, p. 284).

Preliminary surveys showed three possible locations for a sewage farm within a short distance of the borough. An area of 40 acres covered with pine and scrub oak growth located 2½ miles from the town was finally selected. Here a concrete set-

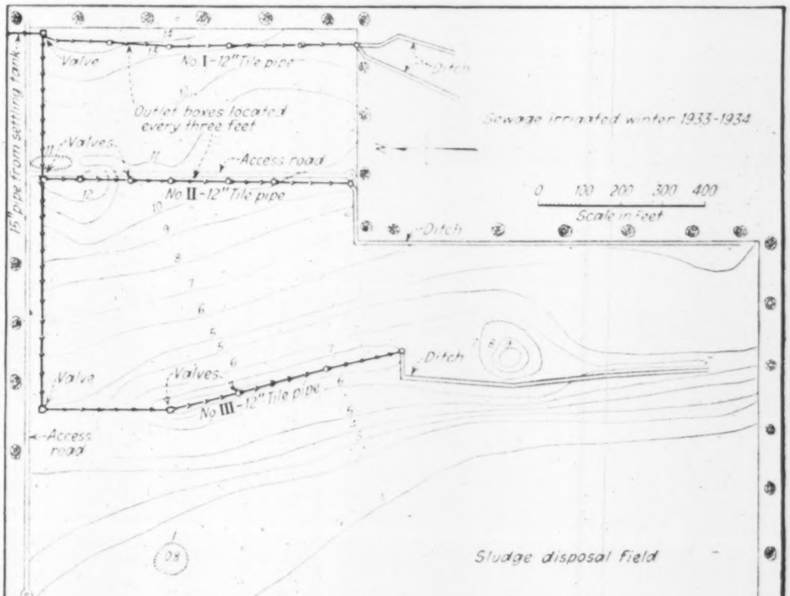

Fig. 1. **Layout of the Vineland sewage irrigation farm showing cultivated section areas at different elevations, each served by a separate distribution line located at the high point of the section.**

tling tank—60 ft. wide, 100 ft. long and 15 ft. deep, divided into four chambers—was constructed and connected with the town sewerage system. Equipment for pumping settled sludge from the tank was also provided. An effluent line was constructed to the edge of the land used for farming.

The general layout of the area farmed (about 14 acres), the sludge disposal area, and the pipeline used for distribution are shown in Fig. 1. When the disposal plant was first built ditches were constructed through the cultivated area where the present pipelines Nos. I, II, and III, are shown on the map. After a short period of operation these ditches were replaced with 12-in. tile pipelines supplied with outlets. The chief difficulty with ditch irrigation was that washouts would occur occasionally and, if not discovered immediately, permitted the unregulated diversion of the sewage where it would damage growing crops and erode the land. These ditches were also objectionable because of the appearance and odor of sewage flowing in them.

Distribution system details

The settling tank with a capacity of about 500,000 gals. and a detention period of about 2 hr., is located about 900 ft. from the nearest corner of the farm. The effluent is clear (except when the tank is nearly filled with sludge) and flows by gravity through a 15-in. pipeline along the north side of the farm. From this line there are three distributing feeders, of 12 in. pipe, serving three cultivated areas; each line can deliver a maximum flow of 850 g.p.m. A shut-off valve is located at the inlet to each section of the feeder line which is provided with two-way outlets at 3-ft. intervals along its length; flow from individual outlets can be regulated.

Construction details of the distributor lines are shown in Fig. 2. It is essential that all the outlets between valve boxes are of the same elevation and the variation should not be more than 0.02 ft., especially where small flows are involved. Even with all outlets at the same elevation it is sometimes difficult to make the sewage flow down all the furrows at the same rate of speed. For controlling the flow from individual outlets, as is frequently necessary because of unequal rate of flow down these furrows, concrete cast cylinders are laid across the outlet. Although some leakage occurs this is of little importance.

Land slope and flow

The slope of land to be irrigated can be less than 6 in. or more than 3 ft. per 100 ft. under certain conditions, but for general crop production these limits should be closely observed. At the Vineland farm a slope of 0.7 to 1.5 per cent has given the best results. On soils of a heavier type than many of those in southern New Jersey a very light grade is desirable. With too steep a grade, even on a very poor soil such as that at Vineland, a great deal of attention is required in changing the flow from section to section. This difficulty can be overcome somewhat by dividing the main stream of sewage among several sections. When this is done, however, the flow in all but the last section will be less from the outlets at the end than those at the beginning. With a grade of much less than 6 in. per 100 ft. on coarse sand the area that can be irrigated during a drought in hot weather becomes very limited. On the other hand, for sewage disposal without crop growing, a very slight grade is desirable, provided the land is kept free of weeds by cultivation.

The layout of the Vineland distribution lines, Nos. I, II, and III, into sections (Fig. 1) was based on the following principles: (1) the flow during the day should be about 15 g.p.m. for each furrow on sandy soil; (2) where the slope is steep the volume of flow can be less; (3) the difference in elevation between outlets of adjoining sections should be at least 6 in.

In actual practice, however, these principles could not be strictly adhered to at the Vineland farm without excessive grading. Because of less than 6 in. difference in elevation between the outlets of each of the four lower sections of line, No. I, there is some flow from the outlets of the sections above the one in use. Where the desired difference in elevation of sections could not be secured, the overflow can be prevented by using larger pipes (to eliminate friction resistance to flow), or outlets can be plugged to avoid overflow.

The ideal irrigation layout would provide for the sewage to reach the ends of all the furrows in a section at the same time. This condition can best be approximated by: (1) having all outlets in a section differ in elevation not more than 0.02 of a foot; (2) by making all furrows the same width and not having them cluttered with weeds or debris; and (3) by having all of the furrows at nearly the same grade.

Land preparation and crops

Some grading is usually necessary on land used for sewage irrigation. In addition, to avoid the possibility of sewage effluent getting into streams or too near public roads, an earth embankment should be built around the field. It may also be desirable to build a ditch around the field to carry away storm water runoff so that the absorptive power of the soil is not lessened.

Experiments have shown the desirability, if not the necessity, of practicing different methods of irrigation according to the nature of the crop. Flooding, for instance, is not practical during the growing season but it can be used for winter disposal. On any sandy land, field corn or sweet corn is planted in the bottom of which are made furrows 3 ft. apart. Sewage flows down these furrows until the corn is about 3 ft. high and then the ground is ridged; irrigating furrows, however, are left between the rows. In the late fall at the Vineland farm furrows are made and early in the spring onion seed is sowed along one side of the furrow. Between June 15 and July 15 sweet corn is planted in the furrow opposite the growing onion sets. When the corn plants are very small the onion sets are gathered. Egg-plants are then set on one side of shallow furrows made 6 ft. apart. Irrigation furrows are made farther and farther away from the plants until, when the fruit is ready to be gathered, the sewage flows in furrows 3 ft. from the plant. This prevents the fruit from coming into contact with the flowing sewage. The roots grow laterally with sufficient rapidity to avoid any check in plant growth from lack of water as the irrigation furrow is moved.

Irrigation practice

In 1936 the crops were irrigated more frequently than had been done in former years. As a result a larger area than formerly was irrigated with

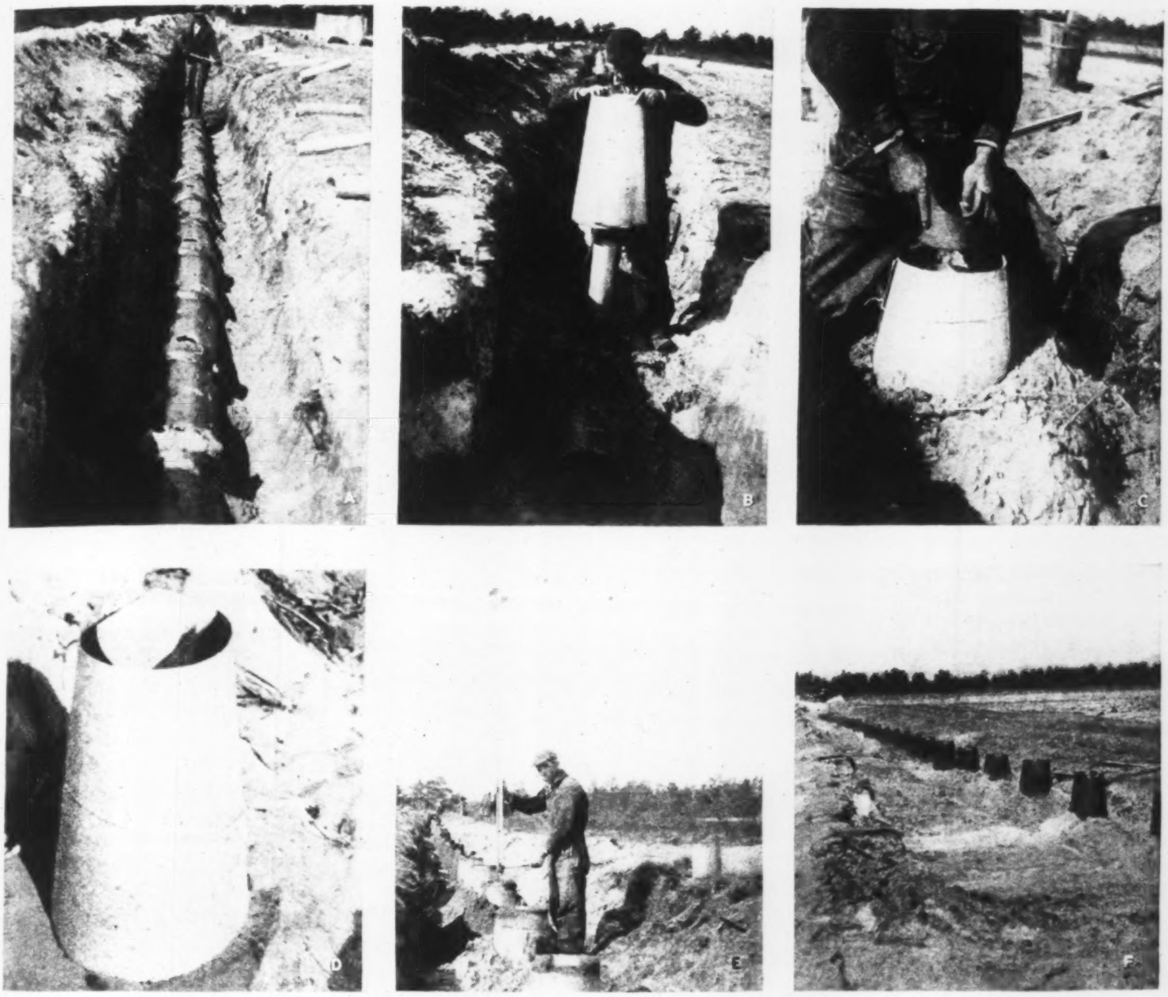

Fig. 2. **Outlet construction details on a distribution line: (A) 12-in. tile pipe pierced with holes at 3 ft. intervals; (B) riser sleeve and metal concrete form; (C) outlet casting being set on riser top; (D) plug in place and ready for concrete; (E) adjusting outlet elevations to the same grade; and (F) completed outlets along the distribution line.**

less damage during dry weather. When the sewage flows down the furrows at intervals of two or three days, more land can be covered than when the flow occurs only once a week. With frequent sewage irrigation in furrows a glazed surface is formed which renders coarse sand less pervious and permits more rapid flow of effluent down the rows. This condition disappears after a week with no irrigation. The glazed condition is also removed by rain to such an extent that it has been found advisable, on the very coarse sand at the Vineland farm, to continue irrigation of crops during and immediately after rain instead of disposing of the sewage on non-crop land when rain furnishes sufficient water for growth.

While the sanitary engineer aims to use as little land as possible in disposing of sewage, it should be borne in mind that the object of the farmer, who uses sewage for irrigation, is to secure the greatest possible value from the water and fertilizer in sewage, and therefore should cover as much land as possible.

During late fall and winter, because of convenience and plenty of available land, the greater part of the sewage effluent at Vineland is disposed of in woodland or in non-crop flat lands. Seventy days' flow was discharged on woodland in the winter of 1933-34 and automatically spread over only 2½ acres. Where sewage irrigation is practiced on good farmland, it is possible to use winter sewage for fertilizing purposes.

On the coarse, sterile sand of the Vineland farm experiments have indicated that only phosphorus, of the fertilizing elements present in sewage, is retained in the soil for any length of time and that when growing plants are not present, the nitrogen and potash readily pass into the drainage water. Humus-making material was incorporated in plots of this coarse sand for several years and no beneficial effects were shown on sewage-irrigated crops when compared with results on plots from which humus-making material had been carefully removed.

Crop production

During a five year period—1929-33—experiments on crop production were made at the Vineland farm. Unirrigated but fertilized and limed land failed to produce crops of consequence because this land is not fitted for farming under ordinary conditions. For instance, sewage irrigated field corn yielded 70 bushels per acre while the unirrigated but fertilized corn yielded less than 7 bushels per acre. Asparagus was the only sizeable crop produced on fertilized but unirrigated land.

Use of lime and fertilizer together with sewage irrigation, over a period of five years, resulted in the conclusion that while fertilizers would in many cases increase the yield of crops, the increase was not sufficient to pay for the fertilizer used. Liming the soil the year after it was cleared of trees and brush proved a profitable operation on most crops, eggplants being a notable exception.

Many crops not mentioned have been grown successfully in an experimental way at Vineland. Because of local commercial conditions, sweet corn is now the major crop. If less labor in growing and marketing were desired, field corn would be a good crop. Soy beans and forage have also been produced with good success.

Esthetic considerations

There seems to be no adequate proof that sewage irrigation, if properly conducted, is a menace to health. Generally speaking, crops that are eaten raw should not be sold from a sewage farm. However, tree fruits and nuts are sewage irrigated quite extensively and presumably with safety when proper precautions are taken.

Some institutional sewage irrigation plants are located near private dwellings and traveled highways and have caused no complaints from nearby residents. Institutional sewage is fresh, whereas Vineland borough sewage becomes septic while being collected and piped 2½ miles from the farm. Although there are odors around the settling tank, (which is well away from dwellings), as a rule the odor from the effluent on the farm is slight. It is believed that these odors could be controlled by the use of chlorine but there is no need at present to incur this additional expense.

Revenue and cost data

The products of the Vineland farm are sold mostly to dealers in nearby towns and consumers who come directly to the farm for supplies. The income from the farm in 1936 compared favorably with those of average farms in the vicinity. This means that a family can occupy the farm buildings owned by the borough, take care of the disposal of the effluent from the settling tank in a sanitary manner throughout the entire year, and secure adequate compensation therefor by farming the land.

Superintendence of disposal of the effluent is a duty of the farmer. Almost daily attention is needed for this, except in winter. Care of the settling tank, including sludge disposal, is a duty of borough officials. The sludge, which is in a partly digested state, is removed from the tank once or twice each year. It is spread over the land and either plowed under the soil or permitted to lie in the fields until dry and then burned.

The total cost of the Vineland sewage disposal plant, installed in 1927-28, was $146,472.29. The following items of this total are of interest in this discussion:

Pipeline to settling tank..	$68,124.15
Settling tank	21,873.00
Pumping equipment	5,266.11
Land and farm buildings.	21,210.00
Pipe from tank to farm..	11,072.66
Farm distribution system.	2,671.90

The total cost is covered by serial bonds extending over 30 years. Since all the construction except pumping machinery and valves is of a durable nature, the expense for an indefinite period after this time will presumably consist of operation only. The annual operating costs are about $600. If no crops were grown, and therefore no revenue received, the operating expenses would be in the neighborhood of $1,450 per year.

When crops are grown, the routine outlined in this article, or similar good farm practice, must be adhered to if paying crops are to be secured. It is questionable whether the land operations necessary for sanitary disposal of sewage would be efficiently carried out year after year if the desire for good paying crops were not an incentive.

The experience of the last two decades in New Jersey has shown that sewage disposal by irrigation of crops is sanitary, practical and economical on good farm soil as well as on sterile sand not suitable for crop production by the usual method of farming. Many towns and institutions could profitably employ this method of disposal.

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Water and Sewerage Improvements Advance in New York State

Water and sewerage improvements throughout the state of New York have been advanced by at least a quarter of a century due to the availability of state and federal funds for unemployment relief, according to C. A. Holmquist, director, division of sanitation. Ninety-two sewage treatment plants have been constructed in New York municipalities since federal funds were made available, and when plants now under construction are completed the volume of sewage receiving treatment in these plants will be considerably greater than that being treated in plants previously constructed.

In 1936, under PWA, 27 water supply projects estimated at $5,000,000 and 17 sewerage projects estimated at $4,500,000 were completed and placed in operation; 14 additional water projects and 13 sewerage projects estimated at $15,000,000 were placed under construction.

Outstanding PWA projects have been the sewers and treatment works for the city of Buffalo, the Coney Island sewage disposal plant, intercepting sewers to the Wards Island disposal works, and the treatment plants at Niagara Falls, Auburn and Elmira; water filtration plants have been completed at Newfane, Plattsburg and Sodus Point. Outstanding projects undertaken through WPA have been the sewers and treatment plant in Onondaga county, the Albany and Buffalo reservoirs.

During 1936, 22 new distributing systems, 22 new or additional sources of water supply, 14 storage reservoirs, 6 filter plants, 17 additions to filter plants, 12 chlorination plants, 14 chlorination replacements, 47 general improvements and 96 major water main extensions were completed. In the sewerage construction field progress is reflected by the completion during 1936 of ten comprehensive sewer systems, 9 sewage treatment plants, improvements to 12 disposal plants, and 44 major sewer extensions.

Structures to Control Torrents

by R. E. Cruse

Captain, Corps of Engineers, U. S. Army, Los Angeles, Calif.

Debris basins, detention dams, open and covered channels and channel crossings present a striking variety of flood-control structures in Los Angeles County

The long battle of Los Angeles county, California, to protect its growing population and land values from torrential floods was outlined in Engineering News-Record, *July 1, p. 22. Two years ago the county asked federal aid through the Works Progress Administration and one of the conditions of the WPA grant was that the construction should be under the direction of the Corps of Engineers U.S.A. The WPA funds were restricted to ten specific items of work and the description that follows is limited to these items.*

—Editor

When the army engineers took charge of the Los Angeles county flood-control work, the county flood-control district had assembled all the known records of rainfall, runoff and related matters, and had set up and operated gaging stations for rainfall and for stream flow, test plots for measuring runoff and other activities to acquire reliable information on which to plan its work. By 1935, the district had developed a comprehensive plan for the control of floods on all the major flood producing streams, washes and canyons, and had completed in accordance with this plan the work summarized in the preceding article.

The projects that are the subject of this article were selected by the flood-control district as being the most important and urgent items in the comprehensive plan on which work could be started immediately. When these projects were approved, and the funds for their construction were made available to the federal engineers, the flood-control district made available all its hydrology and hydraulic records and computations, and also such structural and other planning work as it has been able to develop within the short time after the passage of the Emergency Relief Appropriation Act. The Engineer Department at the same time started independent computations from available records; in general, the results obtained have agreed with those made by the county flood-control district.

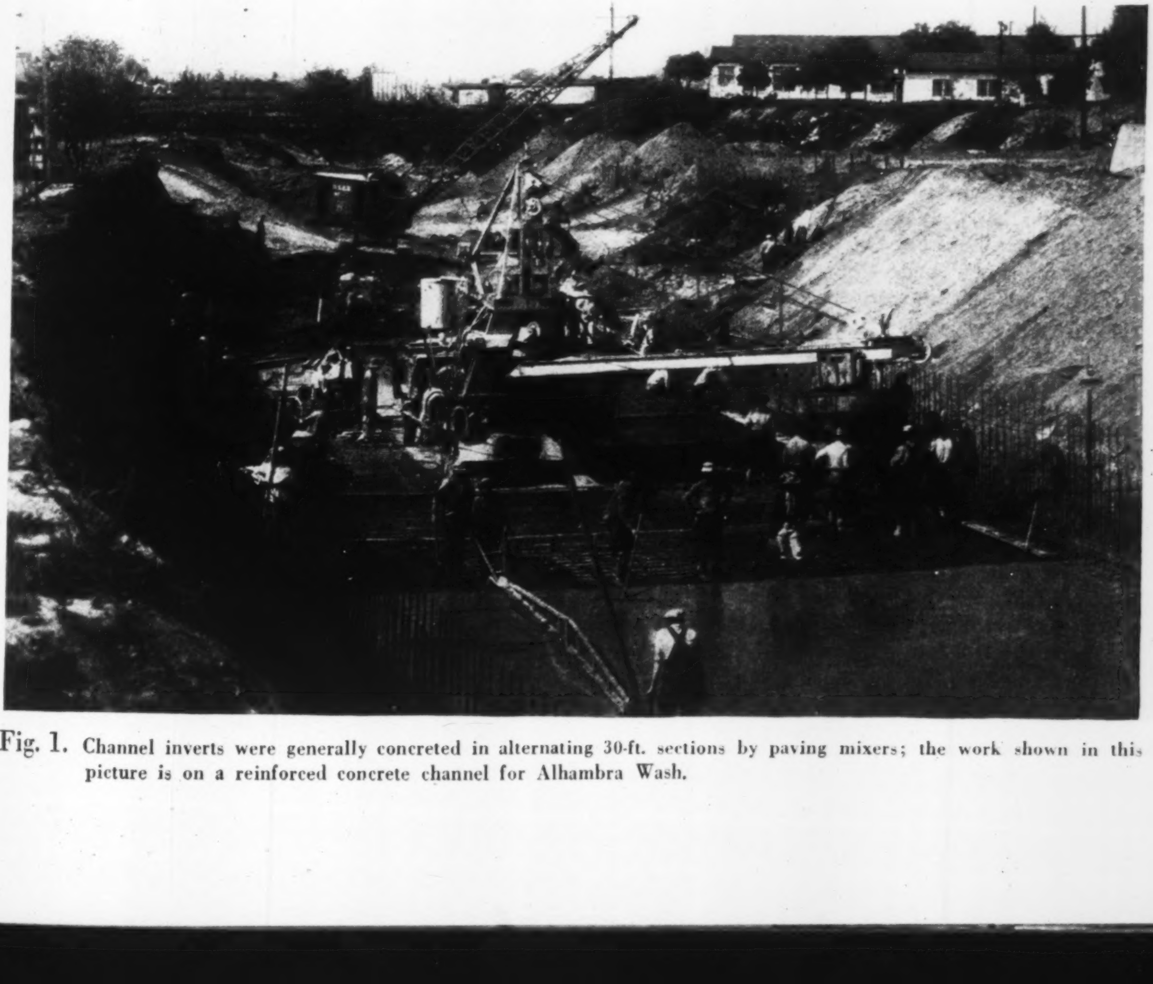


Fig. 1. Channel inverts were generally concreted in alternating 30-ft. sections by paving mixers; the work shown in this picture is on a reinforced concrete channel for Alhambra Wash.

The projects planned are named in the accompanying tabulation, and the structures divide into two main classes: (1) Debris basins and dams at the mouths of mountain canyons, with outlet channels leading to the main river drainage system, and (2) channels for the enlargement and improvement of certain portions of the Los Angeles River and its principal flood-producing tributaries, and Ballona Creek.

As an indication of the variety of work involved the following count of structures is given first:

Trapezoidal channel with paved banks, miles	21.8
Rectangular reinforced concrete conduit, open and closed, miles	30.2
Brick elliptical arch conduit, miles	2.9
Tunnel, concrete lined, mile	0.1
New highway bridges designed, number	38
New railroad bridges designed, number	12
Slab street crossings on channels, number	73
Bridges altered or extended, number	6
Footbridges, number	4
Pumping plants, number	2
Dam with controlled gates, number	1
Debris basins and dams, number	8

Even this formidable list does not completely represent the number and variety of operations as for example: Since practically all channel is located within a congested city, the number of gas, water, electric, telephone, sewer and other lines crossing the channel necessitated an enormous amount of detail planning. A very troublesome problem was to determine the location, size, elevation and capacity of the necessary inlets and inlet structures to take care of side and tributary drainage; many additional drainage provisions were made necessary by the increased height of the new channel levees or side walls which often shut off surface drainage. There are hundreds of these side inlets which vary as designed from a single 18-in. flap gate to banks of five 84-in. gates. Each had to be made a separate study, and agreement reached with the city concerned as to capacities, location, elevation, etc.

In channels at least a 2-ft. freeboard was provided above the maximum computed water surface, and in addition to the superelevation at bends, allowances were necessary for curvature and for side inflows. Whether the channel should be trapezoidal, with rock-paved banks, or a reinforced concrete rectangular section, was influenced by the width of right-of-way available; by the size of the required cross section, and, in this particular job, by the type of channel that, other things being equal, would give the most direct labor.

The walled or rectangular channels are in most cases made up of two walls with an invert slab. Some of the walls are T-shaped cantilevers designed for strength and stability against pressure from either side with no aiding pressure on the other side, while other T-shaped walls are of the counterfort type. The greater portion of the conduit walls are L-shaped with the base forming part of the invert slab. Special consideration was given to detailing these bases so as to set up actual points of relief to moment bending and to allow assumed quasi hinges, this design resulting in a considerable economy of material.

In one case, Verdugo Channel, there was an existing rectangular concrete conduit of inadequate capacity which proved troublesome as it was not desired to destroy the recently built conduit but to make use of it if possible. In the upper reaches of the channel where the elevations of the street crossings could be raised, a concrete channel was added on each side of the existing channel thus making use of the old channel as part of the invert and creating a new channel 87 ft. wide with two interior walls (Fig. 6). In the lower reach, however, where the street crossings could not be raised, it was necessary to remove the old conduit entirely so that the new invert could be lowered.

For the trapezoidal channels, the standard levee section adopted has 1 on 3 side slopes, the stone paving being carried from the channel toe to the computed maximum water surface, and spalls from this point to the top of the levee. Paving stone is placed perpendicular to the bank, and at the bottom of the bank slopes toe rock is placed in an excavated trench as a protection against undercutting, the depth of the toe stone being gov-

Description of Projects

1. *Sycamore and Verdugo Washes*—Verdugo Wash collects drainage from the Verdugo and San Gabriel mountains; flows through Glendale into Los Angeles River; construction rectangular reinforced-concrete conduit 87 ft. wide 5.2 mi. long; side drainage inlets, and reconstruction of all bridges; Sycamore Wash is construction within Glendale of detached pieces of closed concrete conduit; total length 3.275 ft.

2. *La Crescenta-La Canada and Haines*—Construction small dams at the mouths of canyons in the San Gabriel Mountains north of Glendale; behind dams are basins in which debris brought down by floods may be caught and clear water only delivered into Verdugo Wash by rectangular reinforced-concrete conduits from the spillways to Verdugo Wash; total debris capacity of basins 225,000 cu.yd., total length of outlet channels 32,000 ft.

3. *Ballona Creek*—Drains western Los Angeles, Hollywood, Beverly Hills and Culver city; 9.200 ft. above Washington Boulevard is a rectangular reinforced-concrete conduit 80 ft. wide, capacity 25.350 sec.ft. at Washington Boulevard; Washington Boulevard to the Pacific Ocean, 37,800 ft., trapezoidal section hand-laid rock paving; high banks for 8,700 ft. below Washington Boulevard, rectangular concrete conduit with sloping banks above; discharge 46,000 sec.-ft. at the Pacific Ocean; bridges rebuilt.

4. *Los Angeles River*—Main river 8.9 mi. in the northern part of the city, and 2.4 mi. through the industrial district enlarged and straightened to a trapezoidal section by excavation and levees; side slopes hand laid paving.

5. *Long Beach Northeast Drainage System*—Northeast Long Beach; natural drainage toward a low area: excavation of a reservoir with a capacity of 161 acre ft.; water pumped into the Los Angeles River.

6. *Rubio Wash*—San Marino and San Gabriel, into the Rio Honto; improvement of the channel 4.5 mi. by a rectangular reinforced-concrete conduit from 26 ft. to 48 ft. wide; discharge capacity at lower end 13.500 sec.ft.; replacement of a number of bridges.

7. *Alhambra Wash* — Junction of streams, drains eastern Alhambra and flows into the Rio Hondo; construction, for 7 mi. reinforced rectangular concrete conduit of various dimensions: mouth 50 ft. and discharge capacity 12.500 sec.ft.: replacement of several bridges.

8. *Eaton Wash*—Mouth of Eaton Wash. northeast of Pasadena; construction a rolled fill earth dam with overflow spillway and controlled outlet gates, forming a debris and retarding basin with a capacity of 1,050 acre ft. which serves a drainage area of 11.5 sq.mi.; dam 2.000 ft. long. maximum height of 60 ft., 800,000 cu.yd.

9. *Compton Creek*—In 8.3 mi. drains Compton and flows into the Los Angeles River; enlargement of creek; a rectangular reinforced concrete conduit 50-60 ft. wide for upper 5.6 mi.; the lower 2.8 mi. to the Los Angeles River a trapezoidal section with hand laid rock side slopes; requires the construction of a large number of street crossings.

10. *Kenter Canyon*—A detached drainage channel through Santa Monica for 2.9 mi. into the Pacific Ocean: entire channel is under the streets of Santa Monica in elliptical brick arch with reinforced concrete invert, from 8.5 to 11.0 ft. high; outlet capacity of 2.020 sec.ft.

erned by the velocity of the stream.

Closed conduits are used at street crossings and locations where it is necessary to have cover; the sections are 1-, 2- and 3-span boxes. The structures are designed as rigid frames, considering both vertical and horizontal linear deflection.

Running through cities the channels called for many crossings by street bridges. Each bridge was a special study because the channel under the bridge must meet hydraulic requirements, and the bridge itself, if completely redesigned and rebuilt as most of them were, was subject to many restrictions rightly imposed by the county, city or whatever body had control. It was necessary to plan the most economical bridge of required width and span, and to hold the elevation of the street surface to a point where a traffic hazard would not be created. This latter was the most difficult of the bridge problems as the great increase in the channel sizes necessitated much longer bridges than formerly existed and short spans and piers introduced obstructions to flow that in most cases could not be permitted. The channel was bridged at some 129 street crossings without raising the street grade and since practically every street crosses the channel at a different skew, each bridge had to be individually computed and detailed.

Simple-span rolled-beam bridges with either timber, reinforced-concrete or concrete-filled grid floors are used up to about 50-ft. spans. For longer spans, built-up plate girders are used where a truss bridge is not required. In many cases the depth between road grade and free-board line is so small that very shallow beams or girders are required and this necessitates building up the section so as to keep the deflection within allowable limits. The concrete-filled grid floors were found useful in providing a thin slab of light weight.

Two main types of continuous spans are used: the continuous plate girder on roller supports and the continuous rigid frame. In all cases the method of restraints is used for either the design or for the check and all members of variable moment of inertia are treated as such. In one special case where the concrete channel contains two interior walls (Fig. 6), a continuous rigid frame construction was used so as to take advantage of these walls as center piers without increasing their thickness. In this case, structural steel H-sections were used for the center legs and were encased in the concrete wall.

An interesting situation arose at nine of the crossings on Verdugo Wash channel in Glendale where clear spans of about 100 ft. were required that would not raise the elevation of the existing streets, would provide unobstructed vision of traffic on the bridge from cross streets, would be suitable in appearance for a high class residential district, and would be without overhead bracing between trusses. After considering many types of bridges, structural-steel Vierendeel girders were adopted, being the first of their type to be used in the United States so far as known. This type of girder is illustrated in Fig. 7. The first analysis for these girders was made for members of constant moment of inertia by the method of restraints, using influence lines to give maximum moment, shear and thrusts. After detailing the girder a check was made, using a modified form of the deformation method and considering the members as having variable moment of inertia.

Figs. 2-3. **Debris basins (above) at canyon mouths catch the torrent-carried earth and stones while clear water flows over the spillway to the flood channel below. At Eaton Wash (lower picture) an 800,000 cu.yd. rolled fill earth embankment 2,000 ft. long and 60 ft. high forms a retarding basin of 1,050-acre-ft. capacity.**

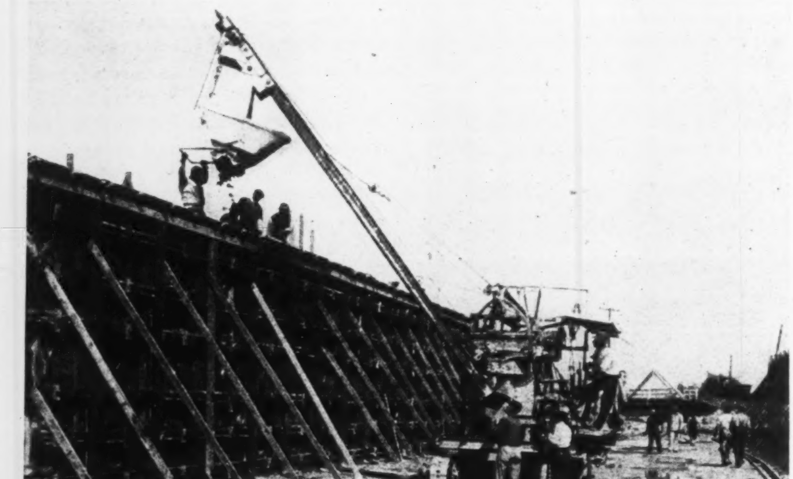
Organizing for construction

When flood-control work was assigned to the Los Angeles army engineer district, the existing organization was very small and it was necessary immediately to expand. The unemployment-relief considerations also made it desirable to execute the work by hired labor rather than by contract. Within about two months the district office organization had been expanded from about 12 to some 400 people, initial plans and designs had been prepared and all projects were under way in the field. Employment from all sources increased very rapidly reaching the peak of 16,400 persons in August, 1936, with an average of about 94 per cent taken from the relief rolls of Los Angeles county.

Laboratory—A testing laboratory was established at the beginning to test the various materials of construction, to design and control concrete mixes, to determine the proper amount of moisture, rolling and degree of compaction necessary for soils used in the earth dams and to conduct the various soil tests. By laboratory control the concrete mixes have been designed in accordance with the character of the aggregate, thus money was saved while maintaining a high quality. The concrete used has been required to reach an average strength of 3,400 lb. in 28 days and most of it has tested higher than this permitting several increases in the water-cement ratio.

Field Operations—On account of the size, complexity and dispersion of the jobs, it was necessary to decentralize control in the field by creating three field areas, each in charge of an area engineer. The areas were further subdivided into jobs, each with a job engineer in charge. Each area set up its own centrally-located yard in which forms were fabricated, reinforcing steel cut and bent and concrete aggregate batched for truck delivery. One area had the additional duty of establishing and operating the large district quarry and of delivering stone to all the jobs requiring it.

Plant and Labor—Higher authority having specified that all jobs be completed by Nov. 1, 1936, sufficient excavating equipment, concrete mixers, trucks and other plant and equipment were obtained and assigned to meet this schedule. All jobs were operated on a 24-hr. basis to meet the early completion date and so that the maximum number of men could be put to work at once. The requirement that at least 90 per cent of the total personnel be secured from the relief rolls imposed an initial handicap of a lack of skilled labor. Many of the skilled trades were practically nonexistent on the relief rolls. Further, certain types of work such as hand-laid stone bank paving had not been previously employed in this locality and it was necessary to import from another engineer district the instructors to organize and train large gangs of pavers.



Figs. 4-5. Vertical channel walls were commonly concreted by crane and mixer operated on the channel floor, as shown in the view of Alhambra Wash at the top. In Santa Monica the Kenter Canyon drain is a three-layer reinforced-brick arch built on a reinforced concrete invert.

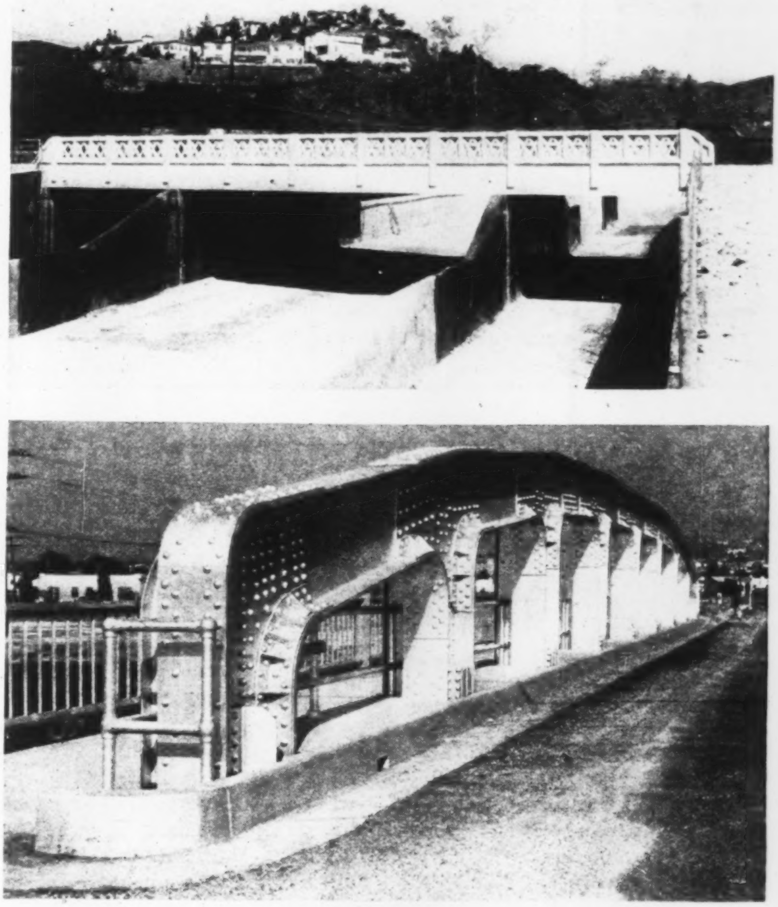
Main construction items

Excavation—The entire project requires the excavation of 14,105,000 cu.yd. of material, practically all of which must be hauled to spoil areas or to storage piles and then rehauled to the job for backfill; this is imposed by city development along the channels. Not to delay starting the work, rented excavating equipment and trucks were used at first but it was soon found that economy and efficiency dictated the purchase of government-owned equipment. On the large channels, 2-yd. shovels and draglines were used, the material being taken from under the machines by 4-yd. trucks. On the smaller channels, 1¼-yd. draglines and shovels were used and either 4-yd. or 2-yd. dump trucks. All equipment purchased is of the diesel or semi-diesel type and has stood up excellently under the 24-hr. operating schedule for more than a year.

In the lower two miles of Ballona Creek, owing to the saturated swamp land and tidal water, it was at first thought that the excavation would have to be made by dredging, but a rented walking dragline with a 10-yd. bucket was put on the job and this machine has completed the work with a most excellent record, averaging 7,500 yd. of saturated material per day at a cost of 12½ c. per yd.

Concrete Work—The project required the placing of about 502,600 cu.yd. of concrete all of which is reinforced and a large percentage of which is in thin wall sections. Concrete aggregate was dry batched at the central yard in each area and delivered by batch trucks to the concrete mixer on the job. Cement was usually delivered directly to the mixer though in some cases where delivery was difficult, the cement was taken to the batching plant in paper bags, placed on the batch trucks as required and opened at the job. The mixers assigned to jobs were ½- and 1-yd. machines, the number depending on the progress required for completion by Nov. 1, 1936. Aggregates were delivered to batching-plant stock piles with delivery to the batch bin by bucket elevators or endless belt conveyors. The reinforcing steel was delivered by rail in stock lengths to the area materials yards where hand-operated cutting and bending equipment was used to prepare the steel for delivery to the job ready to put into the forms.

Inverts and walls were in general poured in 30 ft. sections with expansion joint material between sections and all sections keyed as additional precaution against slab uplift by underground water pressure. On all channels where the machine could operate from the channel floor a 1-yd. mixer with 50 ft. boom (Fig. 1) was used to pour the invert in alternate sections, while the wall sections ranging in height up to 16 ft. were placed by crane and bottom dump concrete bucket (Fig. 4). On the smaller channels where the equipment had to be worked from the banks, the inverts were placed by chuting or crane and the walls placed by crane. All concrete was thoroughly vibrated by electric or air vibrators and forms were stripped within 25 hours after pouring. An asphalt cutback was applied to the concrete immediately after the forms were stripped to effect better curing.



Figs. 6-7. The continuous rigid frame bridge with steel H-section center legs incased in the concrete partition walls shown at the top was built to take advantage of special conditions at one point on Verdugo Wash. Below is shown a Vierendeel-girder bridge over Verdugo Wash in Glendale, the first of nine bridges of this type to be built.

Quarry Operations—Good construction rock is very scarce in the vicinity of Los Angeles but a site for a quarry was finally located in the Santa Ynez Canyon in the Santa Monica Mountains capable of producing the million tons of stone required. Production was set up to conform to the required completion date of the job and at the peak of operation the quarry produced about 6,000 tons of stone per day, this being hauled to different jobs with an average length haul of 15 miles. Two types of stone of excellent quality were obtained, sandstone in the lower reaches of the canyon and a stratified limestone near the top of the mountains. Three faces were worked.

Paving stone was produced in three general sizes, 18-in., 12-in. and 8-in., the size required depending upon the velocity of the water in the channels. After breaking, the stone was loaded into 2-yd. steel skips and the trucks were loaded from the skips by crane. The toe stone placed in the trench at the bottom of the sloping channel banks was loaded directly into trucks with a 2-yd. shovel. At the peak of operation, five shovels, nine air compressors, five 5-ton cranes, 36 jackhammers, 174 4-yd. dump trucks and other equipment were employed on a 24-hour basis in the quarry. At the beginning of quarrying operations, there were few qualified quarry men in Los Angeles county and practically the entire personnel of 3,500 men was trained on the job.

Safety—In accordance with the policy of the Engineer Department to make every effort to promote safety on its work, and recognizing that special precautions in this line would be required with the relief labor to be used both district and area safety sections were established at the very beginning of operations and were trained in their functions before work commenced.

At the commencement of operations it was difficult to obtain physically qualified trained personnel for the various types of skilled work necessary in such a large operation. It was often found necessary to obtain unskilled laborers from the relief rolls, and to train them in placing reinforcing steel, working in concrete, stone paving and quarrying. Furthermore, the turnover of employees on such a relief job added considerably to the cost of the work. In some cases, delays encountered in obtaining the necessary rights-of-way necessitated costly moves to prevent shutting down the job and laying off the relief employees. In general, however, the costs obtained for the various items of the work were quite reasonable considering the employment difficulties and the fact that work was prosecuted during the rainy season when it would have been more economical to suspend operations. Following are representative figures for some of the major items in the job,

Excavation Including, for most of the material, an average 1 mile haul by truck to spoil or temporary storage	$0.19 per yd.
Reinforced concrete in thin walls	12.00 per yd.
Concrete invert slab	9.00 per yd.
Reinforcing steel (in place)	0.04 per lb.
12-in. hand laid stone paving	25.00 per 100 ft. sq.
Structural steel erection cost	18.00 per ton

The work was carried on by the Los Angeles District Office, Corps of Engineers, Major Theodore Wyman, district engineer.

New Expansion Joint Proves Good

by Elmer J. Webb

Civil Engineer, Division of Highways, Syracuse, N. Y.

Bent dowels used with premolded filler give free play to the moving pavement and hold up slab ends under crossing loads

TRIAL of a new expansion joint for concrete pavement has been giving excellent results on the new Cayuga Lake Boulevard in New York state. The installation was sponsored by G. W. Pinck, district engineer, New York State Division of Highways, and was made in the summer of 1936 by John Bellardino in connection with his contract to build 11 mi. of concrete pavement between East Varick and Taughannock Falls. R. S. Pollard was engineer in charge of the contract. The new device is called the flexible dowel (patent pending) and was designed by the writer.

Each dowel of the size and spacing required by the slab design consists of two deformed steel bars and two form or seal plates. The bars (Fig. 2) are bent to place one end (c) in the upper portion of one slab and the other end (b) in the lower portion of the adjacent slab. The vertical portion (a) falls in a slot in the expansion joint filler. The vertical portion (d) rests on the subgrade and acts as a chair during installation of the joint. A pair of these bars is used, being placed in alternate positions in the two slabs, as shown in Fig. 2.

The form-plates (Fig. 3) used to seal the slot in the expansion material through which the dowels are placed, also act as a form to provide the slight recesses (a) in the ends of the slabs, necessary for the vertical portion of the dowel, when the pavement slabs are at extreme expansion. The projections (b) that fall in the expansion recess, hold the vertical portion of the bar in the proper position. The holes (c) guide the horizontal sections of the bars into the slabs.

The expansion filler is slotted in accordance with the number and size of the dowels to be used. One plate is fastened over each slot before delivery to the job for assembly and installation. The plate reinforces the filler around the slots, making handling easy and preventing breakage: it also simplifies assembly of the joint in the field.

To assemble the complete expansion joint unit, the dowels are inserted through the slots in the filler, and the holes in the previously attached plate. The second plate is then placed over the dowels and is in turn fastened to the filler, completing the unit. The assembled joint is then pinned in place in the usual manner, (Fig. 1) and the slabs are poured.

The horizontal sections of the bars, being fully bonded in the two slabs, the load stresses are transferred

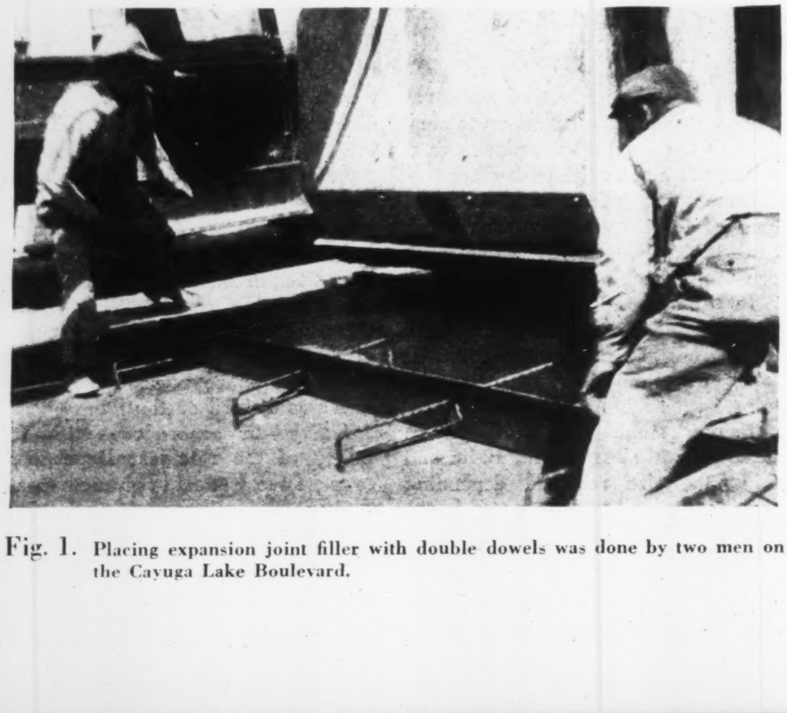


Fig. 1. Placing expansion joint filler with double dowels was done by two men on the Cayuga Lake Boulevard.

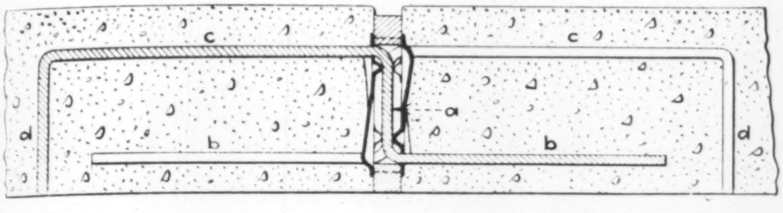


Fig. 2. Expansion joint showing the assembly of the double dowel and the form-plates that hold them in the premolded filler.

through the vertical section. Free movement of the slabs in expansion or contraction is provided through the vertical bends.

Installation procedure

The Cayuga Lake Boulevard is located on the west slope of Cayuga Lake and was built over entirely new right-of-way. The grading involved several heavy cuts and fills to bridge the deep ravines created by the many creeks flowing into the lake. This particular project was selected for the test, because it presented the extreme conditions for complete test.

The joints were installed by the contractor's regular gang consisting of unskilled labor, with no special equipment and no unusual consideration given to the work. A fiber filler was used, to which one form-plate was fastened before delivery to the site of the work. A common laborer, instructed in the method of assembly, took an average of 7 min. to assemble a complete expansion joint unit. The units were placed on the shoulder, and when the paver (operating on the subgrade) had passed over the joint location, two men lifted and pinned the joint in place. Installations were actually made in less time than is usual, there being no adjusting or readjusting necessary from the time the joint was pinned in place to final finishing, because the character of the assembled unit makes tipped joints and misaligned dowels an impossibility.

Inspections have been made at frequent and regular intervals since the casting of these joints. Careful measurements checking the joint gaps have disclosed without exception that every test joint moved in exact ratio to the temperature and atmospheric changes. (Recorded temperatures ranged from —10 deg. F. to 115 deg. F.) No signs of joint failure and no cracks have developed in any of the slabs equipped.

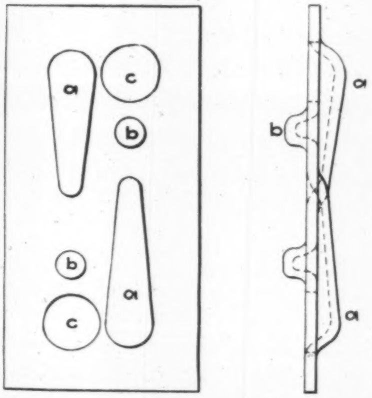


Fig. 3. Face and side of the form-plate that is a vital element in the joint assembly shown by Fig. 2.

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Waterworks Construction Financed by PWA Funds

More than 52 per cent of the waterworks built in the United States in the past four years received financial assistance from the Public Works Administration according to a special report made by the PWA project division on June 17 as the agency entered its fifth year. Accompanying the report was a detailed breakdown of all PWA waterworks constructed since its creation four years ago. It was pointed out that:

1. The average population of a community which obtained PWA assistance toward the construction of new or the improvement of old water supply systems was 940.
2. The average cost of the community was $33,175 per plant, or $35.29 per capita. Engineers declare this is far below the usual average cost, which ordinarily runs from $60 per capita up.
3. PWA waterworks projects, which included the construction of new systems as well as extensions to existing plants, provided for the installation of 457 reservoirs, 940 storage tanks, 105 dams, 1,149 wells, 1,077 pumping plants, 465 water treatment plants, 146,298 house connections, and 22,948 fire hydrants.

Under the first Public Works Administration program, the government grant was 30 per cent of the combined expenditure for labor and materials. The grant under the program authorized by the Emergency Relief Appropriation Act of 1935 and the first Deficiency Appropriation Act, fiscal year, 1936, was in an amount not exceeding 45 per cent of the total cost of the project.

The importance of this program, it was stated, is best indicated by a comparison of the total contracts awarded for waterworks construction of PWA projects with the total waterworks contracts awarded as reported by *Engineering News-Record* for the 48 states during the period from July 1, 1936, to Jan. 1, 1937. During this time contracts awarded on PWA waterworks projects amounted to $147,231,274, or approximately 52½ per cent of the ENR total of $280,648,000 for such construction. For this same period, the F. W. Dodge Corporation reported waterworks construction contracts amounting to $162,257,300 for the 37 eastern states. The PWA waterworks contracts for these 37 states amounted to $104,203,815 or 64 per cent of this total.

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CCC Will Enroll 54,000 This Summer

Following approval by Congress of a bill extending the life of the Civilian Conservation Corps for three years, immediate selection of 54,000 young men and war veterans for enrollment as replacements to the corps has been approved. The operating program provides for maintenance of the corps at a strength of 300,000.

The call for 54,000 replacements was based on a survey conducted by the War Department which shows that the strength of the CCC would drop to approximately 246,000 by the end of the first six months of 1937.

FROM FIELD AND OFFICE

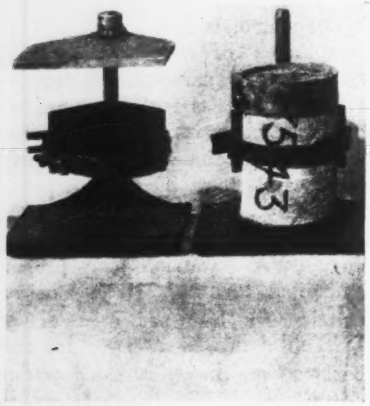
Working problems and time-saving methods . . . Edited by Charles S. Hill

Caps for Pavement Cores

by V. L. Glover

Engineer of Materials, Division of Highways, Springfield, Ill.

A device which will cap to any thickness, with absolutely parallel ends, test cores cut from concrete pavement, is used by the bureau of materials of the Illinois Division of Highways. It consists of a cast iron baseplate, 7 x 8 x ½ in.; a 4 x 4 x ⅜ in. angle 3 in. long, equipped with a strap for holding the core; a rod, ¾ in. in diameter; a galvanized iron band, and a top plate. One side of the base plate is raised and reinforced, and through this is drilled a ¾-in. hole for the rod, which may be held in any position by the thumb screw in the base plate. The ⅛ x 1-in. strap is hinged to one leg of the angle, and is fastened to the other leg by bolting it to a 1 x ⅜ x 2-in. slotted piece fastened to the angle. The strap conforms to the perimeter of the core which is held in a vertical position by means of the strap and angle.



Core capping device for test cores from concrete pavement.

A galvanized iron band 1½ in. wide, made so that it may be clamped around the core, is used in capping the upper end. The top plate, made to slide over the ¾-in. rod, is used in adjusting the galvanized iron band so that the latter is parallel to the base plate when ready to receive the upper cap. A steel shim about 4 x 2 x ¼ in. is used to obtain the thickness of cap desired. A small sliding collar fitted with a thumb screw is also clamped to the ¾-in rod to hold the core in any position desired.

The cement paste for the upper cap is placed within the band and pressed down firmly, sufficient paste being used so that its surface is slightly above the rim of the band around the core. A piece of oiled or waxed paper is then laid over the cement paste and on this is placed a smooth glass plate which is pressed down until it rests on the top rim of the band, thus securing a smooth surface and proper thickness for the cap. The apparatus is then set aside until the caps harden.

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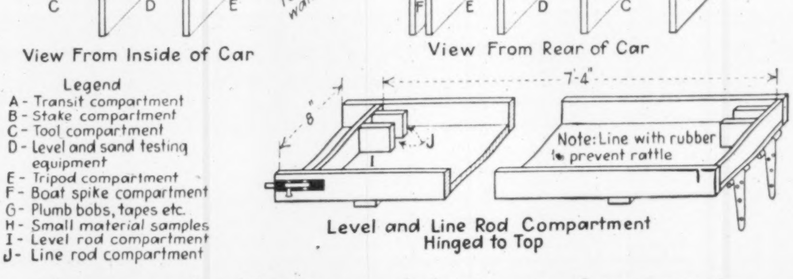
Instrument and Tool Car

For Survey Party

by D. G. Cackler

Department of Public Service, Akron, Ohio

A car for survey parties and their equipment of instruments and supplies has been adapted from a light truck for use by the Akron, Ohio, city engineering department. The department purchased a light car of the "station wagon" type, and removed the rear seat of the three provided by the manufacturer. This left a space in the rear for the equipment to which there is easy access through a drop door in the rear of the body.


4"
2'3"
A
H
B
G
B
C
D
E
Fender wall
View From Inside of Car
A
B
B
F
E
D
C
Fender wall
View From Rear of Car
Legend
A - Transit compartment
B - Stake compartment
C - Tool compartment
D - Level and sand testing equipment
E - Tripod compartment
F - Boat spike compartment
G - Plumb bobs, tapes etc.
H - Small material samples
I - Level rod compartment
J - Line rod compartment
8"
7'4"
J
I
Note: Line with rubber to prevent rattle
Level and Line Rod Compartment Hinged to Top

Instrument cupboard fitted to rear end of station wagon for survey parties.

This space was separated as shown by the accompanying drawing into compartments for the use of levels, transits, tools, testing apparatus, tripods, stakes and the other materials a survey party carries.

The car as originally equipped has the upper half of the rear opening closed with a curtain. This curtain was removed and fastened to a wood frame which in turn was hinged to the top of the car, assuring a full opening for the removal of equipment. A long board, 8 in. wide, with a stiffener along each side and grooved blocks and stops at each end was attached to the underside of the top of the car to hold level and line rods. The board is hinged at the front end, which makes the rods easily accessible and also allows the board to be raised out of the way when the rods are not in use. The rear of the board is securely fastened by two slip bolts which work into notches cut into a strip of steel reinforcement placed along the upper rear of the car.

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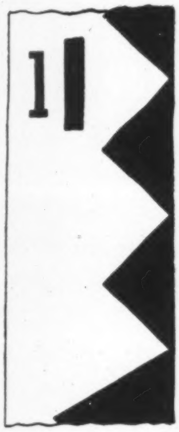
Design for Stadia Rod

by Gordon Dinsmoor

Topeka, Kan.

The ordinary level or stadia rod with its small graduations for hundredths of feet becomes, during a long run, hard to read by the transit-



Strain-reducing stadia rod

man because of eyestrain. As a means of combating this strain and its consequent lower efficiency, a rod graduated according to the design in the accompanying illustration, would enable the instrumentman to distinguish quickly and easily the tenths of a foot, and closer readings could be secured by using the target vernier. The illustration shows a section of the rod, from 0.5 ft. to the 1-ft. mark. Odd numbered tenths, such as 5, 7 and 9, are at the apex of the white triangles. The 1-ft. numeral and bar, which are shown in black here, would be in red on the rod.

A width of 3 in. for the rod, as is shown here would be an added advantage, reducing considerably the total surface exposed when the rod is fully extended in a high wind. This would reduce the strain on the rodman, thus allowing more accurate placing of the rod.

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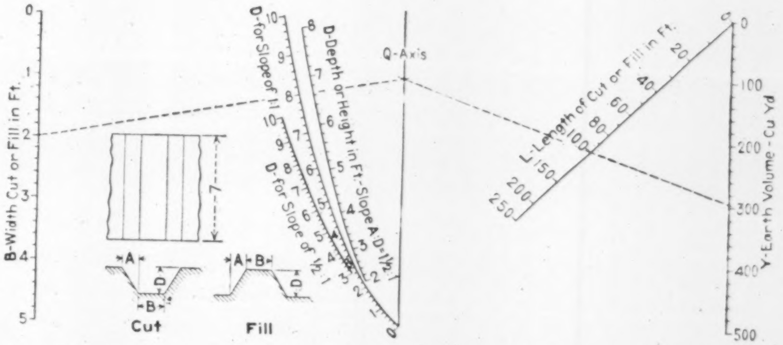
Cut and Fill Volume Told by Chart

By Norman Arnold and F. H. Warner

Engineering Department, Purdue University, Lafayette, Ind.

A simple chart is shown by the accompanying drawing for computing volumes of earth which must be moved in making cuts or fills of trapezoidal shape over level ground. The chart may also be employed when the ground is sloping, if D is the mean depth throughout the length, L.

As an example, a ditch is to be made having a bottom width, $B = 2$ ft.; depth, $D = 8$ ft.; slope of sides $A{:}D = 1.1$, and length $L = 100$ ft. How many cubic yards of earth must be removed? The answer is obtained from the chart by drawing a straight line from $B = 2$ ft. through $D = 8$ ft. on the middle D-scale to the Q-axis; from the point on the Q-axis draw a straight line through $L = 100$ to the Y-scale, and read 295 cu.yd.



Earth-volume chart for computing volume of symmetrical trapezoided cuts and fills.

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Columns Upended and Set By Special Sling

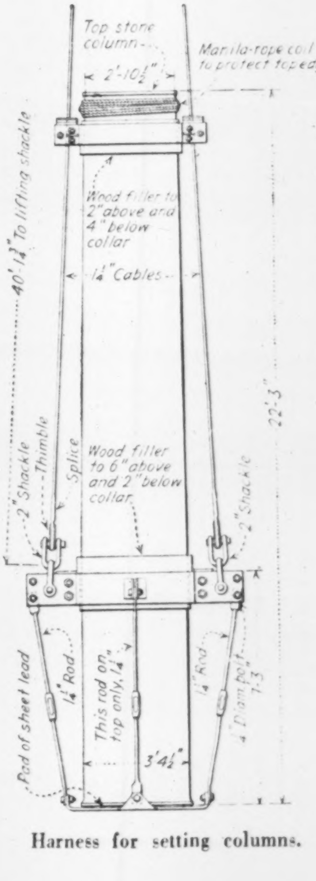
By G. W. Maker

Aberthew Co., Boston, Mass.

The limestone exterior of the building for The Christian Science Publishing Society at Boston includes eight large columns over the main entrance. Each of these columns is 40 in. in diameter, 22 ft. high, and weighs about 15 tons. Because of a specification requirement that even minor damage to any item of limestone would be sufficient cause for rejection, it was considered advisable to devise a special harness for lifting these columns into place.

This harness, shown by the accompanying sketch, consisted principally of two heavy steel collars, each in two sections, with a wire rope bridle shackled to the lower collar and passing through the flanges of the upper collar. These collars were clamped onto the column over a belt of soft wood lagging.

To protect the fillet at the base of the column from possible damage when raising the column from a horizontal to a vertical position, a base plate was formed of heavy steel with a square boss welded to the center to fit into a corresponding square hole in the base of the column. This plate was formed with turned-up ears at three of its quarter-points (the top and both sides when the column was lying horizontally) and rods taken up by turn buckles were carried from these ears to the lower hoisting collar. As the column was raised the load was first taken by the top collar, which served principally as a guide after the column reached a vertical position. The steel base plate was then released and the column lifted into place. The time required for unloading and placing one column was about two hours.


Top stone column
Manila-rope coil to protect top edge
2'-10½"
40'-1¾" To lifting shackle
Wood filler to 2" above and 4" below collar
1¼" Cables
22'-3"
2" Shackle
Thimble
Splice
Wood filler to 6" above and 2" below collar
2" Shackle
Pad of sheet lead
1¼" Rod
This rod on top only, 1¼"
1¼" Rod
4" Diam. bolt 1'-3"
3'4½"

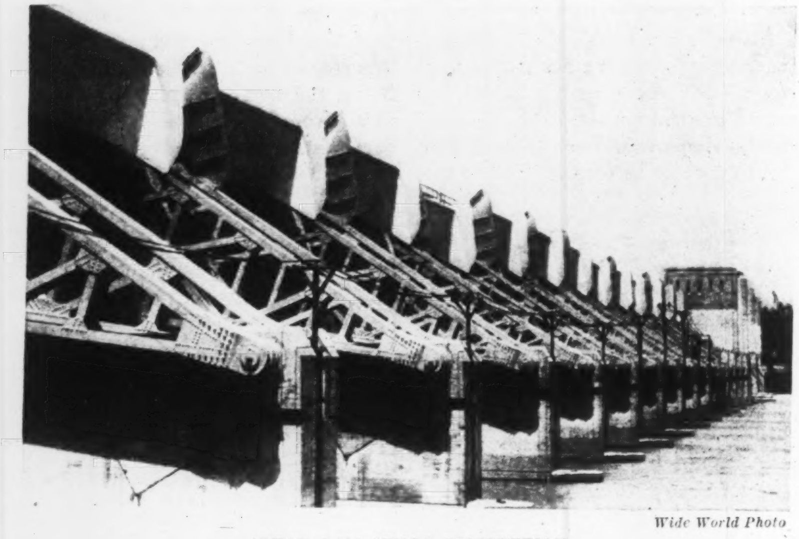
Harness for setting columns.

$3 to $5

paid on acceptance for items suitable for the pages of From Field and Office.

THE WEEK'S EVENTS

(*Continued from page 47*)



Wide World Photo

ALTON DAM NEARS COMPLETION

Tainter gates shown are some of the 30 included in the Alton Dam in the Mississippi River at Alton, Ill., part of the 9-ft. channel program which will provide navigation as far as St. Paul and Minneapolis. The dam, which is more than 1,700 ft. long, will contain 30 Tainter gates and three steel rolling gates. Navigation will be passed through two locks, 110 ft. wide.

All that remains for completion of the dam is construction of two more gates, and the smaller auxiliary navigation lock.

Stream Pollution Control In Pennsylvania

(*Continued from page 47*)

An exemption from the industrial waste provision is granted for acid mine drainage from coal mines in active operation at time of the adoption of the act; this exemption will apply until such time as in the opinion of the sanitary water board practical means of treatment become known

Pollution study

The Sanitary Water Board is empowered to make a complete survey of the waters of the state to ascertain the extent of the pollution and the remedies to be adopted. It is also authorized to conduct researches to ascertain reasonable and practical means for the treatment of industrial wastes.

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Diversion in Reverse

The Michigan legislature on June 10 voted to divert $5,000,000 from sales tax revenues to be used for state highway construction purposes.

Government Engineer Fees Studied by Council

The staff of the American Engineering Council has just completed a report, undertaken at the request of the American Society of Civil Engineers, which includes a comprehensive survey of government agencies employing engineers on a contract, per diem, or percentage fee basis.

Each of these government agencies was interviewed regarding its practice, and an examination was made of laws, regulations and procedures affecting the engagement of technical, and particularly engineering, services by the federal government. More than 30 important agencies are listed in the report, with references to the laws or rulings governing procedure in each bureau and the fees paid or the method for determining the fees. The extent of use of consulting engineering services is also indicated in many instances.

The Engineering Council expects to mimeograph copies of this report for all member engineering organizations as soon as the final draft has been approved by the Council's committee on the engineer's economic status.

Extend Civil Service Committee Urges

Committee on Administrative Management urges all federal jobs be placed under civil service

Extension of the merit system to all positions in the federal service except a few policy determining posts was urged by the President's Committee on Administrative Management, which has been studying the proposed government reorganization plan, in a study made public June 28. The study recommends that all persons now filling exempted positions be required to take qualifying examinations and be certified by a "non-political personnel officer, that they have served with merit for not less than one year."

It is recommended that the present civil service commission of three members be abolished, and be replaced by a single administrator who would be advised by a non-salaried civil service board of seven citizens.

The study finds the existing civil service commission is poorly organized and is inadequate to serve as an effective agency to develop able personnel management. "Its major interests," the report says, "appears to remain in the negative and restrictive activities dependent upon the enforcement of the civil service laws and rules, rather than in a positive and cooperative approach towards improved recruitment, placement, training and morale-building activities." The commission is handicapped at present by its organization into a board of three members not professionally trained and by its lack of a broad training program for its employees.

Personnel agency

The study recommends that a central personnel agency be established in place of the civil service commission, headed by a single administrator, coordinate in position with the director of the bureau of the budget, who would be a trained personnel man chosen by competitive examination and appointed by the president from an eligible list. This agency would perform or coordinate all of the personnel work now done by central agencies, and would undertake activities now largely neglected, such as promotion of employee training, transfers, health and safety programs and employee relationship.

The duties of the personnel administration would be to assist the president in developing recommended personnel legislation and in providing for general regulations of personnel matters within his discretion, to assist the heads of major agencies in the development of effective personnel administration, and to act as the central review agency for personnel classification and for salary control.

Advisory board

It is also recommended that a civil service board be established composed of public spirited citizens appointed by the president on a part-time basis for overlapping terms, with the duty of protecting and improving the merit system. The board would appoint committees of examiners to administer examinations for the position of head of the central personnel agency, would approve the membership of other special examining committees to hold examinations for highest civil service positions, and would approve persons to serve on boards or committees of mediation and personnel relations in connection with the federal service.

It is urged that all high administrative functions be divided into two groups: one definitely policy-forming in the political sense, and the other purely administrative and non-political. The non-political group in each department or agency would be headed by a non-political executive officer equivalent in rank to an under-secretary.

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Approach Bids Received For Lincoln Tunnel

Four bids for the construction of the New Jersey approach to the Lincoln Tunnel were received by the Port of New York Authority, June 21. This first unit of the express roadway approach structure extends from the east side of Pleasant Avenue to the east side of the Hudson Boulevard East; in Weehawken.

George M. Brewster & Sons, Inc., of Bogota, N. J., offered the low bid of $2,287,000. The Underpinning & Foundation Co., of New York was second with a bid of $2,291,000; Poirier & McLane Corp., of New York bid $2,313,000, and Rustiano & Sons Corp., of New York bid $2,342,000.

The completed express highway will consist of two three-lane roadways, starting as a viaduct structure from the south end of the Weehawken plaza of the tunnel and curving to the east, north, and west on a rising grade to reach the high level of the plateau above the Palisades. This loop viaduct structure will cross Hudson Boulevard East twice and will also cross Park Avenue and Pleasant Avenue.

Ultimately the approach will continue as a depressed highway across the full width of the Palisades, becoming a viaduct structure again after passing under Hudson Boulevard West and descending to make connections with state highway routes No. 1 and No. 3 at the edge of the Hackensack Meadows.

The present contract covers a section of steel and reinforced concrete elevated highway. The structure will be about 170 ft. wide and will require 72,000 cu.yd. of excavation, 16,000 yd. of concrete and brick masonry, 2,500 tons of structural steel and 1,500 tons of reinforcing rods.

Work under the contract will require about 1½ years.

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Park Department to Build Hotel at McKinley Park

The Federal government will begin construction by July 15 of a new $350,000 hotel in Mount McKinley National Park, Alaska, using WPA funds. The National Park Service is preparing plans and will supervise construction. Upon completion, the hotel will be operated by the Alaska Railroad. Mount McKinley National Park, which is administered by the National Park Service, Department of Interior, lies between Seward and Fairbanks.

Many of the unusual conditions of this country make construction difficult. The land on which the hotel is to be built is composed of thick, spongy, moss and dirt and vegetation on gravel and frozen earth. In addition to the hotel structure itself, a complete utility plant must be constructed.

Plans and specifications are being completed by the National Park Service for advertising for bids. The building will be under roof in the Fall at the end of the short Alaska construction period. Interior work will continue through the winter and spring, and the hotel will be ready for occupancy by the next travel season. A Park Service architect will advise on construction.

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Two Housing Contracts Let

Contract has been let for the construction of the last project on the PWA low rent housing program with award of the contract for erection of the Baker Homes development in Lackawanna, N. Y., to the Fleisher Engineering & Construction Co. of Buffalo, on its bid of $1,329,000.

A contract has also been let which will increase the size of Jane Addams Houses, the $6,950,000 project in Chicago, by 243 dwelling units. The contract, for construction of four additional buildings, was awarded to the Patrick Warren Construction Co. of Chicago, on a low bid of $751,255.

Chicago Railway Tunnel Held Not Taxable

The Illinois Supreme Court, in a recent decision (*ENR*, June 17, 1937, p. 893), held that money expended by a street railway grading company on tunnels owned by the city did not give the company a taxable interest in the tunnel. The case arose from an attempt on the part of Cook County, Ill., to collect taxes against the interest of the Chicago Railway Co. in tunnels under the Chicago River at North La Salle St. and West Washington St. The county contended that the company's interest constituted a lease-hold estate and was taxable as real property, the only type of property over which the local assessors have jurisdiction. The company sought to enjoin collection of the tax in the Circuit Court of Cook County and obtained an injunction. On appeal to the Supreme Court the lower court's decision was upheld.

History of controversy

The La Salle St. tunnel was built in 1870, and the Washington St. tunnel somewhat later, by the city. At the time predecessor companies of the Chicago Street Railway Co. were authorized to operate street railways through the tunnel. In 1904, when the War Department declared the tunnels an obstruction to navigation, and ordered them lowered, a city ordinance directed a predecessor of the railway company to reconstruct the tunnels in accordance with the requirements of the War Department. This deepening and reconstruction was required to be done wholly at the expense of the street railway company, provided that if the city should terminate the right of either of the companies to use the tunnel, the city would pay to the company the actual cost of lowering and reconstructing the tunnel.

The railway companies performed the changes as directed, at a cost of $3,062,000. The cost of this work was set upon the books of the company in its capital account and was included in a purchase price at which the city retained the option of buying the property.

The court held that this item in the company's capital account, while a proper element of capital and a proper asset of the company for rate-making purpose, did not constitute a lease-hold, but was rather in the nature of a franchise, of exactly the same nature as the right of the company to operate over the public streets, and therefore constituted an intangible item which could not be taxed by the local government.

CALENDAR OF MEETINGS

Royal Sanitary Institute, 48th Congress, Birmingham, England, July 12-17.

American Society of Civil Engineers, annual convention, Detroit, Mich., July 21-24.

American Water Works Association, Central States Section, Dearborn, Mich., August 18-20; North Carolina Section, Wilmington, N. C., August 26-28; Rocky Mountain Section, Santa Fe, N. M., September 20-22.

California Sewage Works Association, annual convention, San Jose, Cal., September 13-14.

New England Water Works Association, annual convention, Poland Spring, Me., September 21-24.

OFFICERS ELECTED

Frederick W. Bliss, manager of sales promotion fo· General Electric Company, Boston, was re-elected president of the Engineering Societies of New England at the recent annual meeting; Holcomb J. Brown, consulting engineer, Boston, and Leon F. Jackson, Linde Air Products Company, Boston, being made vice-presidents. Joseph Peterson of the Massachusetts Department of Public Works was elected treasurer and Harold C. Hamilton, head of the Boston Edison laboratory, was made secretary. Members-at-large on the executive committee include Prof. Holton James, Massachusetts Institute of Technology; Prof. Albert E. Haertlein, Harvard Graduate School of Engineering; and two past-presidents, Geo. A. Montague, Massachusetts Department of Public Works, and Chester A. Corney, Boston Edison Company. The keynote of the annual meeting was co-operation among all engineering societies in New England and increased interest among engineers in public affairs for the benefit of the nation.

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$912,000 in Contracts Let by Buffalo

The total of the Buffalo Sewer authority's construction contracts was brought to $11,653,000 June 25, when contracts were awarded for further construction, equipment and electrical work, amounting to $912,000. The largest award went to Lombardo Bros. Construction Co. of Cleveland, who will construct the sludge digestion tanks at a bid price of $456,000. The sludge disposal building will be constructed by F. H. McGraw & Co., Inc., New York City, for $322,000. The International Chimney Co. of Buffalo is building the brick stack for $29,000, and McCarthy Bros. & Ford, Buffalo, are doing electrical work on the sludge disposal process for $37,000.

Contracts yet to be awarded have an estimated cost of $1,433,000. The total contract prices on jobs already awarded indicate the job will be completed within the estimated cost of $15,000,000.

OBITUARY

Frank A. Jordan, 71, building contractor, died June 11 at Spokane, Wash.

Peter P. O'Neil, 73, Lexington, Ky., city engineer for 22 years, died there June 21.

Charles Backoff, waterworks engineer and inspector of Newark, N. J.'s water department, died there recently.

Bruce Wallace, for 36 years in the Detroit office of the United States Engineers, died May 20 at the age of 61.

Edward A. Daly, once assistant municipal director of public works, Philadelphia, died June 23 at the age of 66.

Isaac R. Coles, an incorporator of the firm of Ruggles-Coles, New York, died June 22 in Glen Cove, L. I., at the age of 78.

William McAllister, retired contractor, died in Seattle, June 13, at the age of 81. He built the Seattle post office, the public library and the Arcade Building.

Elias Vander Horst, 68, engaged as a consulting engineer in New York until a few years ago when he became a partner in the hardware firm of William H. Cole & Sons, Baltimore, died at his home in Baltimore, June 23.

Andrew Harper, 74, former Newark engineer, died June 26 in Hongkong, China. After working on several large construction jobs in the United States, Mr. Harper moved to China in 1914. There he supervised the building of a military road from southern China to the Yangtse River.

J. Wallace Tower, consulting engineer and partner in the firm of Hardy S. Ferguson & Co., died in New York June 21 at the age of 66. Mr. Tower, who specialized in the design and construction of pulp and paper mills, had been associated with Hardy S. Ferguson since 1898, and had been a partner in the firm since 1928.

PERSONAL

L. J. Hillis, maintenance engineer at Carbondale, Ill., has been promoted to district engineer in that district.

Byron O. McCoy is now in the office of William P. Creager, consulting engineer, of Buffalo.

Mark L. Allen, formerly office engineer at the Gallipolis dam site, is now construction engineer-designer with the B. F. Goodrich Co. of Akron.

Samuel M. Bailey, senior engineer in the Louisville offices of the U. S. Engineers, has been assigned to the Zanesville, Ohio, office.

James B. Edgerton, assistant engineer on the Huntington, W. Va., district U. S. Engineers staff, is being transferred to the Mobile, Ala. office.

Major Clinton W. Ball, of Fort DuPont, Del., has been assigned as engineer in charge of the Albany office of the U. S. Engineers, effective Aug. 1.

John R. Moynihan has been appointed assistant professor of experimental engineering at Cornell University.

R. L. Painchaud, for ten years director of the Montreal department of roads, has resigned and plans to enter private employment.

W. Vance Baise has been reappointed chief engineer of the North Carolina highway and public works commission.

Ernest J. Noethlich, formerly head engineer of WPA in Columbus, Ohio, has been transferred to the Lancaster, Ohio office.

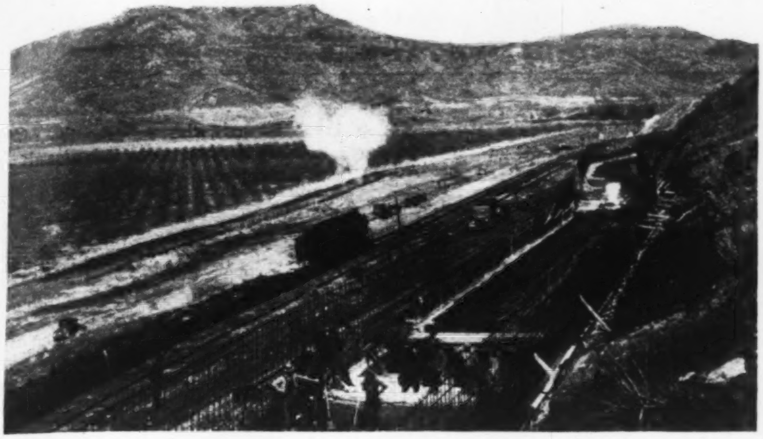
A. R. Carver is acting superintendent of the Wheeling Division of the Baltimore & Ohio Railway at Wheeling, W. Va.

H. L. Exley, who has been division engineer on the Baltimore & Ohio at Grafton, W. Va., has been transferred to Cumberland, Md., in the same capacity, succeeding A. R. Carver.

E. J. Clopton, formerly assistant division engineer, Baltimore division of the Baltimore & Ohio, succeeds H. L. Exley as division engineer at Grafton.

Stephen F. Voorhees, supervising architect at Princeton University, received an honorary degree of doctor of engineering at Princeton's annual commencement.

John M. Egan, civil engineer, formerly with PWA and the Lincoln Park



WATER FOR THE IDAHO DESERT

Main canal of the Payette division of the Boise, Idaho, federal reclamation project, now under construction by the Bureau of Reclamation, will run for part of its length in this reinforced concrete flume built on the toe of the foothills surrounding the Payette Valley. A train is bringing reenforcing steel.

Board, Chicago, has joined the staff of Walter H. Flood & Co., chemical testing and inspecting engineers.

Charles B. Murray, president of Crowell & Murray, Inc., Cleveland, received the honorary degree of doctor of engineering at Worcester Polytechnic Institute, Worcester, Mass.

M. J. Fleming has been appointed acting assistant chief highway engineer of the Illinois department of public works and buildings.

Capus Waynick, former chairman of the state highway and public works commission, Raleigh, N. C., is director of the division of purchase and contract in the commission.

George H. Thurber of the engineering department of the Canadian public works at St. John, N.B., has been transferred to the headquarters of the department in Ottawa, Ont.

Joseph P. Reinheimer, Springfield Ohio, assistant city engineer since 1919, is with the Ohio Edison Co. as assistant resident engineer on construction of an addition to the Mad River power plant.

William T. Morrissey, for the past 17 years engineer of the highway division for the city of Boston, has been named head of the division to succeed the late Joshua Atwood. Mr. Morrissey entered the city's service 22 years ago in 1915.

Boyd A. Bennett, formerly vice-president of the South Bay Consolidated Water Co. of Bay Shore, Long Island, is now president of the Northeastern Water & Electric Service Corp., New York City.

D. A. Somerville, formerly district engineer of state highway district No. 9 at Carbondale, Ill., is now district engineer of district No. 3 in Ottawa.

Hal G. Sours, formerly highway engineer of Summit County, Ohio, and long engaged in county highway work, has joined the Truscon Steel Co. as promotion engineer of highway products. He was active in Ohio roadbuilding work for eighteen years, first as engineer for the state, later with Summit County. Mr. Sours is a director of the American Road Builders Association and is a member of the Ohio Engineers' Registration Board.

A **Personal Item** on page 885 of the June 10 issue stated that N. W. Hicks, P. G. Poore, and O. E. Cutting had been given permanent appointments in the Montana highway department as state highway engineer, assistant highway engineer and secretary to the highway commission, respectively. This information was out of date. The appointments mentioned were made on April 1. On April 8, D. A. McKinnon and W. O. Whipps, who had resigned in January as state highway engineer and secretary to the highway commission, respectively, were reinstated in their previous positions. On April 9 Mr. Hicks and Mr. Cutting were released from the department. A few days later Mr. Poore was reappointed to his former position as pre-construction engineer, and the office of assistant highway engineer was abolished.

State to Set Qualifications For Plant Operators

A New York state law passed by the recent session of the legislature provides that the State Public Health Council may prescribe qualifications for operators of water treatment and purification plants and sewage treatment plants if such operators are paid from public funds. Persons who have been appointed to positions before July 1, 1937, or those appointed from Civil Service lists established before that date are specifically exempted from application of the act, as are operators employed by private corporations.

At the present time the Public Health Council is considering establishment of three grades for operators based upon the size and character of work to be done and the responsibility involved. The qualifications will probably be based both on educational training and on practical experience and so arranged that an operator now employed in a qualified grade would not be prohibited from official recognition as a qualified operator because of lack of education.

It is expected that the state department of health will have definite plans within a few weeks.

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Fee Case on Housing Job Settled Out of Court

Four lawsuits against nine architects on the Kenfield housing project at Lackawanna, N. Y. were suddenly settled out of court June 8, an hour after the first action went to trial. Indications that sensational disclosures would have been made if the case had gone to trial were found in the remark of Justice Larkin in his dismissal of the jury when he said "You and I have missed a very interesting case, gentlemen. It has ended suddenly."

The first suit was brought by George R. White, structural engineer, against the nine architects. Mr. White alleged that the architects owed him $11,000, made up of $7,500 as part of his fee and $3,500 for expenses. The architects contended that $8,400 had been paid to Mr. White and filed a counter-claim for $2,000.

Three other cases were brought against the same defendants by Howard M. Davidson, plumbing and heating engineer; Samuel N. Galvin, electrical engineer, and Daniel S. White, adviser for the project. Inasmuch as the complaints had not been filed, their nature was not made public.

The architects named in the suit were: Chester Oakley, Robert North, Mortimer Murphy, Paul F. Mann, Fred R. Hopkins, Earl Martin, Louis Greenstein, George J. Dietel, and Albert A. Rumschick.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

BITUMINOUS MACADAM PAVING, SYRACUSE, N. Y.

OWNER: City of Syracuse, Wm. Cronin, Engineer.

PROJECT: Construction of 10,080 sq. yd. sheet asphalt pavement with 8 in. concrete base on Comstock Avenue from Madison to Euclid Avenue, including 11,940 sq. yd. grading, 1860 sq. yd. sandstone block, and base reinforcing.

BIDS: Three bids were opened May 17, 1937, ranging from the contract low of $45,444 to a high of $57,602.

CONDITIONS: All materials are to be furnished by the contractor; completion is scheduled for 75 days after award; minimum hourly wage rates stipulated of 90 c. for skill and 50 c. for common labor.

LOW BIDDERS:

1. Cleveland Trinidad Co., Syracuse, N. Y. (contract)	$45,444
2. Street Bros. Const. Co., Syracuse, N. Y.	51,380
3. Dale Engineering Co., Utica, N. Y.	57,602

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Sheet asphalt	10,080 s. y.	$2.70	$2.95	$3.12
2. Sandstone block relaid	1,860 s. y.	3.68	4.95	5.25
3. Grading	11,940 c. y.	.34	.27	.42
4. Concrete curb	350 l. f.	.60	1.00	1.00
5. Catch basin lip, reconstruct	10 l. f.	.25	.40	.40
6. Curved Medina curb	100 l. f.	1.50	1.90	2.00
7. Curb reset	1,000 l. f.	.50	.80	.88
8. Headers	10 l. f.	1.00	1.25	1.00
9. Headers reset	20 l. f.	.50	.80	.50
10. Catch basins, type A	9 each	70.00	85.00	75.00
11. Earth refill	10 c. y.	1.25	1.50	2.00
12. Gravel	10 c. y.	1.90	2.00	2.50
13. Concrete sidewalk	2,000 s. f.	.20	.22	.28
14. Concrete driveways	1,000 s. f.	.30	.30	.40
15. Concrete steps, coping	10 l. f.	2.00	2.75	2.00
16. Concrete steps only	10 l. f.	1.75	2.50	1.75
17. Sewer pipe, 4 in	200 l. f.	.73	1.00	.75
18. Sewer pipe, 6 in	20 l. f.	1.17	2.00	2.50
19. Sewer pipe, 10 in	200 l. f.	1.38	2.25	2.50
20. Manhole, 3 x 4 ft	6 each	75.00	90.00	90.00
21. Manhole tops	12 each	20.00	22.50	20.00
22. Brick masonry	12 l. f.	5.00	6.00	6.00
23. Grade Adams St. west	L. S.	50.00	20.00	100.00
24. Extra asphalt binder	20 ton	6.00	7.50	6.50
25. Extra concrete, 1:3:6	20 c. y.	9.00	9.00	9.00
26. Excavate concrete base	20 c. y.	1.00	1.75	2.50
27. Asphalt surface	200 s. y.	1.00	1.20	1.50
28. Hillside brick surface	20 s. y.	3.25	3.50	3.00
29. Sandstone block	20 s. y.	4.50	3.50	4.00
30. Vitrif. brick relaid	50 s. y.	2.50	2.50	3.00
31. Reinforcing steel	1,500 l. f.	.06	.07	.05
32. Mesh reinforcing	123,500 s. f.	.02	.025	.04
33. Calcium chloride	0.25 ton	35.00	30.00	35.00
34. Std. seal traps	7 each	10.00	10.00	8.50

CAPE COD CANAL DREDGING

OWNER: War Department, U. S. A. Lt. Col. A. K. B. Lyman, district engineer.

PROJECT: Dredging of 3,439,400 c. y. (place measurement) of material in Hog Island Channel, Buzzards Bay, Mass. to a depth of 32 ft. below mean low water, and to varying bottom widths. Material is to be disposed of in dikes, with spoil areas located within 3,700 ft. of the cut.

BIDS: Four bids were opened on April 12, 1937, and ranged from the contract low of $668,619 to a high of $856,411, for the combined sections A and B. One bid only of $690,943 was received for Section B which comprises 60 per cent of the total yardage.

CONDITIONS: Both sections are accessible by highway and railroad. Completion is scheduled within 8 months af contract award, with minimum hourly rates stipulated $1.20 for skilled and 50c. for common labor.

LOW BIDDERS:

1. Atlantic, Gulf & Pacific Co., New York, N. Y.	$668,619
2. Standard Dredging Co., New York, N. Y.	753,229
3. American Dredging Co., Philadelphia, Pa.	856,411
4. Arundel Corporation, Baltimore, Md. (Sect. B only)	690,943

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Dredging Section Z	1,419,100 c. y.		No bids	
2. Dredging Section B	2,20,300 c. y.	(By Bidder No: 4 only=$0.242)		
3. Dredging combined sections	3,439,400 c. y.	$0.1944	$0.219	$0.249

HIGHWAY UNDERPASS, ARIZONA

OWNER: Highway Dept. Arizona, Southern Pacific R. R.

PROJECT: Construction of highway underpass beneath the Southern Pacific R. R. on Mill Ave., on the Tempe-Chandler Highway, ¼ mile south of Tempe, Ariz.

BIDS: Opened April 27, 1937. Seven bids ranged from the contract low of $77,431 to a high of $81,509. Completion is cheduled for Nov. 15, 1937.

MATERIALS FURNISHED: The contractor furnishes all materials required for the complete project.

LOW BIDDERS:

1. Vinson & Pringle, Phoenix, Ariz. (contract)	$77,431
2. Pearson & Dickerson Contrs., Inc., Tempe, Ariz.	79,445
3. W. E. Hall Co., Phoenix, Ariz.	79,746

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Drainage excav. unclass.	1,355 c. y.	$0.42	$0.25	$0.38
2. Struct. excav. unclass.	11,014 c. y.	.34	1.33	5
3. Overhaul, sta. yd.	10,142 c. y.	.025	.015	2
4. Overhaul, cu. yd. mile	3,892 c. y.	.17	.20	.15
5. Select material	1,246 c. y.	.80	.50	.50
6. Sprinkling	36 M. g.	1.40	.125	4.00
7. Rolling	72 hr.	3.00	2.50	4.00
8. Conc. paving, 6 in	2,788 s. y.	2.00	2.00	2.45
9. Conc. paving, 7 in	525 s. y.	2.00	2.25	2.75
10. Remove conc. pavement	2,700 s. y.	.50	.25	.50
11. Concrete, Cl. A	653 c. y.	23.00	20.50	19.00
12. Concrete, Cl. D	415 c. y.	24.00	20.50	20.00
13. Reinforcing steel	150,410 lb.	.052	.019	.055
14. Corrugated metal pipe, 36 in	10 l. f.	6.00	5.00	5.00
15. Std. line fence	3,210 l. f.	.09	.12	.08
16. Markers	12 each	2.50	3.50	4.00
17. Single curb	1,860 l. f.	.78	.70	.75
18. Comb. curb. gutter	1,801 l. f.	1.40	.95	1.20
19. Conc. slab, curb and handrail	total	70.00	135.00	500.00
20. Catch basins and grates	total	650.00	625.00	1,500.00
21. Gunite, 2 in. reinf	26,460 s. f.	.29	.29	.28
22. Gunite, 1.5 in., reinf	14,850 s. f.	.22	.21	.23
23. Concrete sidewalk, 4 in	10,427 s. f.	.25	.17	.23
24. Lead seal, 1/16 x 5 in	600 l. f.	.80	.55	.65
25. Lead seal, 1/16 x 9 in	503 l. f.	1.20	.90	1.00
26. Steel irrig. pipe, etc	total	1,900.00	1,750.00	1,500.00
27. Sodium lamps, standards	2 each	210.00	225.00	300.00
28. Membr., asph. plank waterpfg	total	2,000.00	1,900.00	2,000.00
29. Shoofly pav't., remove, place	total	400.00	700.00	1,000.00
30. Conc. pipe, 18 in	42 l. f.	2.50	2.40	3.00
31. Conc. pipe, 24 in. (in siphon)	10 l. f.	2.50	3.50	5.00
32. Pump, 250 g. p. m., elec.	1 each	600.00	625.00	900.00
33. Pump, 1000 g. p. m., gas	1 each	3,000.00	2,100.00	3,000.00
34. Electrical system	total	1,500.00	600.00	1,000.00
35. Outlet discharge, 10 in	total	500.00	85.00	300.00

(Additional Contract Unit Prices on second following page)